TOPICS OF THE MONTH

Shop window for chemical plant

IN our special June issue we presented an illustrated preview of the Chemical and Petroleum Engineering Exhibition which received high praise from readers who visited our Exhibition stand, and we were gratified to find our preview being used as a handy guide to what there was to see. In this issue we describe a further selection of the exhibits.

Going round the Exhibition on the opening day one came across a number of interesting developments that had not previously been publicised—a healthy sign of the constant endeavour that is made by chemical and petroleum plant manufacturers to keep up with the changing needs of the industries they serve. The exhibition was indeed an eye-opener to those who have not previously realised the remarkable achievements of British plant manufacturers. The surprising number of visitors from Germany and other Continental countries, despite the fact that the Exhibition trod closely on the heels of the Achema which took place in Frankfurt only a week or two earlier, indicates that the chemical and petroleum industries there are becoming aware of these achievements. There is still a need for them to be made much more aware of them through the suitable use of advertising and sales promotion.

This need becomes all the more apparent when one considers the recent accomplishments of some British companies, which were briefly summarised by Mr. H. W. Fender, chairman of the British Chemical Plant Manufacturers Association, in an address at the opening of the Exhibition. He pointed out that British exports have included not only a great volume of individual items of plant but also such notable contracts as the 1,000 tons/day nitrogenous fertiliser plant at Sindri in India, sulphuric acid plants in Australia, New Zealand and Mexico, complete soap works in Malaya and the Belgian Congo, a polystyrene plant in Poland, two superphosphate plants in New Zealand and large pharmaceutical installations for the Government of Burma.

There is no doubt that, if the industry makes further efforts to make its capabilities known to the world—and advertising in the technical press must figure largely here—a great deal more could be achieved.

Towards complete automatic control

FROM the days when lime kilns were charged and discharged by hand, and a man had to run up flights of stairs to take temperatures with mercury-in-glass thermometers, the application of automatic control to chemical processes has reached the stage where all the operations in a plant can be attended to by one man from a central control panel. The extent to which instruments and automatic controls have been applied has changed the whole shape of employment in the process industries. How much further can such developments go? Would it be reasonable to contemplate the time, for instance, when all power stations could be operated from a central point?

Sir Christopher Hinton, who recalls the instance of the lime kilns from out of a lifetime of experience in the chemical industry, has more lately been a prominent figure in the atomic energy industry, and is now chairman of the Central Electricity Generating Board. He is therefore in a particularly favourable position to answer this question. He points out that some of the major problems in achieving further applications of automatic control are human and psychological rather than technical. Automatic controls will look after the plant when it is operating normally or within certain narrow limits of departure from normality, but when through some abnormal circumstance the plant runs beyond those limits, there has to be a skilled man there to deal with the situation so that the plant may be returned to the point where the controls can operate.

The development of complete automatic control, Sir Christopher pointed out, depends on whether or to what extent it is economical, and on finding a way of ensuring that plant management is going to be kept mentally alive during the 99% of the time the controls are looking after the plant, so that they may be alert during the remaining 1% when conditions go beyond the controls.

Evershed's new landmark

SIR CHRISTOPHER HINTON'S remarks on the problems of developing automatic controls still further were made at the opening of a new office block by Evershed & Vignoles Ltd. at Acton Lane, Chiswick, London. He commented that it was pleasing to see British firms occupying a leading and outstanding position in a field which before the war was dominated by American instrument firms.

The new Evershed building, an imposing four-storey block in pleasing modern architecture, is a fitting reflection of the progress of a company whose first premises in Acton Lane, in 1904, consisted of a small workshop and offices at the back of an 18th century house. Sydney Evershed was one of the first to realise the potentialities of electrical engineering and his invention of the *Megger* insulation tester in 1903 was the starting point for a wide range of products which now extend far beyond electrical testing equipment and servo-mechanism equipment to electronic process equipment for oil refineries, chemical and process plants, and apparatus for analytical laboratories.

Fluidised driers in the motor industry

WE are constantly pointing out, with examples, that chemical engineering advances are, or can be, of benefit to practically every industry. This fact is still not well appreciated in many quarters where ignorance of what chemical engineering means leads to the usual confusion because of the word ' chemical.' It always gives us pleasure, therefore, to be able to add to the wealth of evidence against the mistaken notion that chemical engineering is necessarily concerned with the manufacture or processing of chemicals. One recent example occurs in the motor-car industry, more particularly the new Ford Motor Co. foundry at Dagenham, Essex, where an application of the principles of solid fluidisation is to be found.

Here the core sand after washing and draining is subsequently completely dried in thermo venturi driers. In these, hot air at high velocity is blown into the base of the venturi and the wet sand introduced at the narrow throat section. The moving hot air carries the sand into the vertical column where it becomes airborne, or fluidised, travelling upwards and being dried at the same time. Passing from the top conical section of the plant, the now dried sand is conveyed by the air stream to a cyclone separator where it is continuously discharged from the base through a flap valve to a storage hopper or truck. The moisture content is then in the region of 0.3%. The clean air is discharged to atmosphere.

When the Dagenham foundry was first reorganised six years ago the Kestner Evaporator & Engineering Co. Ltd. installed one of their T.V. driers with a capacity of 7 tons/hr. For the new extension two Kestner T.V. driers each of 10 tons/hr. have been installed, giving a total throughput for the foundry of 27 tons/hr.

These plants, to take care of sand erosion, are constructed in cast iron and heavy plate mild steel, with specially designed abrasion-resistant sections at the vulnerable points, such as the feed throat, the top of the column and the entry of the separators.

The air can be delivered to the plant from a gas-fired air heater at about 400 to 450°C. The temperature of the outlet air is about 75 to 80°C. Fully automatic control is incorporated, operated from a centrally situated control panel. By this the quantity of fuel burnt is regulated in accordance with the feed rate, and the moisture content, of the sand entering the drying column. Thus maximum fuel economy is ensured.

New chemical engineering building at Manchester

THE new chemical engineering building that has been opened at the Manchester College of Science and Technology is impressive both in its size and in the scope that it affords for training and research, the main building, including basement, ground floor and six upper floors totalling about 120,000 sq. ft. in area.

The basement of the building is used by the mechanical engineering department for the strength-of-materials and fatigue-testing laboratories, but at one end a portion of the basement some 40 ft. deep and 100 ft. long is used as the bottom storey of the chemical engineering laboratory which extends from the basement through to the ground floor, thus providing access to chemical engineering pilot plants at two levels.

On the ground floor the main lecture theatre and teaching laboratories of the chemical engineering department are placed around a central hall in which facilities for student refreshment are provided. The first floor contains the design office of the chemical engineering department together with research laboratories, a conference room, library and office facilities and lecture rooms. Similar provisions are made, on the upper floors, for the teaching of metallurgy, fuel technology, textile chemistry, industrial biochemistry and machine drawing.

The chemical engineering drawing office provides adequate working space for 60 students and the main chemical engineering laboratory provides for an even larger number. Further extensive pilot-plant buildings have been erected outside the main chemical engineering building. It is not expected that these will be completely equipped until the end of 1960; however, the students have started on the design of the first pilot plant which is to be a tar washing unit and it is hoped to commence erection of this unit during the summer.

Dust sampling development

A SAMPLING apparatus that has been designed for the rapid measurement of red iron-oxide fume emitted with hot waste gases from various steelmaking processes can also be used to measure fine or coarse dust emitted from crushing, grinding, sieving, etc., and from sinter plants. This development arose from experiments carried out by the British Iron and Steel Research Association in connection with the needs of the steel industry emphasised in the Clean Air Act of 1956.

A stainless-steel probe, carrying a sharp-edged nozzle, faces directly into the stream of dusty gas and a sample is withdrawn isokinetically, *i.e.* it flows into the nozzle in the same direction and at the same velocity as the local undisturbed gas stream. This ensures that the dust content of the sample accurately represents that of the main gas stream at that point. The gas sample is then drawn through a weighed filter and cooled below air temperature in the two coils to ensure that corrosive liquids are not condensed in the remainder of the sampling train. Two gas-tight vane pumps, arranged in parallel, then expel the filtered and cooled gas sample through an integrating gas meter and a gas flow-rate indicator. The mass of dust and fume in the gas sample is determined by reweighing the filter, and the concentration is obtained by dividing this mass by the volume of the gas sample.

To calculate the correct isokinetic sampling rate, it is necessary to measure the velocity and temperature of the gases in the stack. This is done by placing

a pitot tube and a sheathed thermocouple near the sampling nozzle, but not obstructing it. Simple tables can be used to obtain the required sampling rate from the pitot-tube reading.

Rates of gas and fume emission from steelmaking processes can vary rapidly with time. To be of use the sampling train must collect a weighable sample of dust and fume in a short period—often less than five minutes—and be ready to take another within a minute. To meet these requirements, the original hand-built apparatus used by the Physics Department of B.I.S.R.A. has been redesigned in collaboration with the Longworth Scientific Instrument Co. Ltd. A robust filter assembly is being constructed which incorporates a throw-away filter of graded glass fibres, held in a reusable stainless-steel canister, the whole of which can be weighed on a chemical balance.

This filter assembly and preformed glass-fibre filters will be commercially available. They will filter iron-oxide fume from corrosive gases at 300°C. at a rate of 3 cu.ft./min. Plans are now being made for manufacture of the complete sampling train. The components are grouped in such a way that users will have a self-contained and compact apparatus. This advantage has been gained without sacrificing the great degree of flexibility in arrangement that is required when access to a duct or chimney may vary from the relative comfort of a staircase and flat floor to a hand ladder and roped scaffold plank.

Photo-electric opacity recording

CLEVER use of a photo-electric cell is made in a new unit for the recording of plant liquor opacity. The operation depends on the light from a projection unit falling on a photo-electric cell mounted in a light-receiving unit. As the light falls on the photo-cell the emission of the cell, and therefore the current through it, is increased and the variations in its current are subsequently measured and recorded.

Tests were conducted on samples of plant liquor which showed the unit to be essentially sensitive to the clarity and opacity of the liquor and from these tests the most favourable conditions of colour and opacity were arrived at. It was also found that a sample of liquor fell within a certain range of percentage obscuration and, from the figures obtained, alarm contacts were set on the recorder to give a klaxon warning when the permissible limit of opacity was being approached.

Tests of meter accuracy are also made during operation when ' dense ' and ' clear ' conditions are simulated. In addition, light-absorption screens can be provided for calibration at intermediate points, two of these being available equivalent to 59 and 82.5% obscuration.

The equipment has been developed by the Foster Instrument Co. Ltd. in conjunction with Laporte Chemicals Ltd., who originally suggested the idea. The recording instrument used is a Foster electronic, potentiometric, self-balancing strip chart recorder calibrated for 0 to 100% obscuration.

Isotopes go a-begging

THAT radioactive isotopes can be a useful tool for investigating problems of mixing, filtration, fluid flow, etc., has been demonstrated on numerous occasions, notably at the Atomic Energy Research Establishment, Harwell. An interesting use of radio-isotopes has now been reported at a small power station in Australia, where the circulation of the water in the cooling pond (a disused reservoir in this instance) was traced by the addition of radioactive iodine to the warm water fed into the pond from the power station. The way in which the warm water mixed with and spread through the reservoir could be followed by Geiger counters.

The experiment, in which the Australian Atomic Energy Commission and the Electricity Commission of New South Wales co-operated, is reported to have been highly successful. It should carry the investigators a big step towards acquiring the necessary design data for the economical construction of cooling ponds for the very large power stations planned for the New South Wales coalfields.

Last year the British Radiochemical Centre at Amersham sent out more than 20,000 consignments of isotope preparations and the demand is growing at the rate of 20 to 25% each year. But, despite the increasing demand for isotopes as tracers and general radiation sources, it would seem that many sections of industry are slow to realise the potential uses. The chemical industry in particular has been singled out as lagging behind in this respect, and some comments on the situation by our associate journal, *Atomics & Nuclear Energy* (June, page 185), are well worth recording:

' Five reasons are usually given why many firms are slow to use new techniques of this kind. The first is the old charge of conservatism and inertia. What can be said about this ? Surely it is a fact that the ones who are progressive and follow the new developments will have applied tracer techniques where applicable, while the backward firms will be backward all the way. Very often it depends on the heads of departments and their attitude to new techniques.

'A bogey which is not really as big as many imagine is the cost—the cost of the equipment and the cost of the isotope preparations themselves. There is no doubt that costs of these two items are on the decrease; this year the Radiochemical Centre is able to offer some 700 standard preparations at lower prices, and a glance at the 1958 catalogue, published recently, will show that the range has been extended.

'As regards equipment, counters of every description have become commonplace items in the manufacturers' lists since the war and, as they became standard items in the catalogues, the prices were reduced. A Geiger counter is no " special " these days—there are thousands in use.

' Perhaps the most important reason for shunning the use of radioactive materials is the problem of health hazards. Some sources must be heavily shielded, but many isotopes need only the simplest precautions. One quarter inch of *Perspex* is sufficient shield for

carbon 14 and it is probably less dangerous than many of the standard reagents handled so nonchalantly every day.

'The last reason which is said to account for resistance to tracer techniques is that the applications are often subtle and not at all obvious. Here the Radiochemical Centre can help, for it offers a comprehensive advisory service.'

There is no doubt, *Atomics & Nuclear Energy* adds, that the attention of many firms should be drawn to the changing position as regards isotopes, and to the undisputed fact that these materials offer, in many cases, easy and faster solutions of problems. It is a matter of education of both managers and technologists.

New smelting process treats lead and zinc

A RECENTLY introduced method of smelting mixed lead and zinc charges is of great significance to low-grade and refractory lead-zinc ore deposits where recovery of separate concentrates is uneconomic or where loss of values in flotation tailings is unduly high. This is the 'improved vertical furnace' process for zinc, details of which have recently been released by Imperial Smelting Corporation Ltd. at Avonmouth, England, and which consists, basically, of charging sinter made up of roasted zinc concentrates and fluxes with metallurgical coke into a blast furnace, into which preheated air is blown through water-cooled tuyères. The coke is burnt to a mixture of CO and CO_2 gases which, together with nitrogen gas, pass up through the furnace charge and reduce the zinc oxide to metal which, being above its boiling point (907°C.), is vaporised and carried out of the furnace with the exit gases, whilst the flux and coke ash in the charge descend to the crucible and are tapped as slag.

Treatment of the gases leaving the furnace, to recover the zinc vapour, is one of the most important parts of the process. Owing to the relatively high CO_2 content of the gases, cooling by normal means would result in considerable reversion to zinc oxide as shown by the equation: $ZnO + CO \rightleftharpoons Zn\,(gas) + CO_2$.

In the 'improved vertical furnace' reversion is reduced to a low level by using a lead splash zinc condenser specially developed for this process. Molten lead (at 550°C.) in the condenser is violently agitated by a series of mechanical rotors dipping into the lead which shower lead as a fine spray through the hotter gases entering the condenser. The lead rapidly chills the gases through the critical temperature range in which reversion would normally occur, allowing the zinc vapour to condense to metal which is dissolved in the lead.

Molten lead containing zinc is continuously withdrawn from the condenser and passes to an external cooling and separation system where the temperature is dropped by 100°C. Zinc in excess of that soluble at the lower temperature separates as a liquid layer on the top of the lead and is continuously removed to a separate bath from which, after a de-arsenification treatment with metallic sodium, it is tapped and cast directly into market shapes.

The cooled lead is continuously returned to the condenser. Furnace gases leaving the condenser are scrubbed to remove residual amounts of uncondensed zinc and lead, and then recirculated as a low calorific value fuel to preheaters and other plant ancillaries.

The new process was described in a recent bulletin from the Lead Development Association, which points out the advantage that this method offers for treating not only zinciferous materials but also mixed lead and zinc charges—the lead being reduced at virtually no extra fuel charge and tapped as bullion from the bottom of the furnace with the normal slag.

Oxygen enrichment and steel productivity

THE development of the use of oxygen in steelmaking processes has been going on for a number of years and methods have become very well established, but the use of oxygen in ironmaking is yet in its infancy. Several theoretical approaches have been made and appraisals published on the possibility of introducing reducing gases together with oxygen into ironmaking blast furnaces, but, so far, little work has been done and no results published. The introduction of an oxygen-enriched blast into the conventional blast furnace has, however, been the subject of experimental work in several countries.

A review of experiments which have been carried out was given recently by Mr. J. L. Harrison, technical adviser on iron and steel processes, British Oxygen Gases Ltd., in an address to the Newcastle branch of the Society of Instrument Technology.

He reported the successful use of oxygen enrichment in American plants where the most satisfactory results were achieved with the addition of moisture to the blast. This contrasts with experience in the Soviet Union, where oxygen enrichment has also been practised and where it was claimed that smooth operation could be obtained without adding moisture to the blast. While this may be true, it is thought that the relatively large increase in productivity in the American trials may be due to the reducing action of hydrogen in the furnace stack. Reports of the Russian experiments stated that there was no significant change in iron quality or in furnace lining. A complete cost analysis was carried out and it was decided that, with oxygen at tonnage cost, blast enrichment would be an immediate practical proposition.

For some years it has been realised that oxygen is exceedingly valuable for the decarburisation of low-carbon steel made in open-hearth furnaces, and the chemistry of the injection of oxygen for this purpose is now fairly well understood. The Steel Co. of Wales have found it possible to take a sample for carbon and sulphur, add lime in accordance with the latter figure, and blow with a predetermined amount of oxygen based on the carbon analysis. The steel is ready for tapping on completion of the blow. Heat is generated by metalloid oxidation and this, together with the physical effect of the oxygen jet, fluxes the lime and provides the high basicity and temperature needed for sulphur removal.

PACKED FRACTIONATING COLUMNS

By S. R. M. Ellis, Ph.D., F.R.I.C., A.M.I.Chem.E., **and J. Varjavandi,** B.Sc.
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The past few years have seen considerable advances in the field of tower packings and, in addition to a variety of ring packings, etc., numerous gauze packings are now available. After a brief general survey of packings and of the effect on column efficiency of liquid distribution and wetting characteristics, this article discusses gauze packings and compares various types from the point of view of pressure drop and other factors.

THE use of glass balls about 1 in. in diameter as a tower packing was suggested by Clements[1] as early as 1820. Also there is a mention in an early patent[2] of a packed column for coal, tar, wood, spirit and alcohol separations filled with coke or pumice stone to effect the interaction between liquid and vapour. Since then, packed columns have been applied to many separation processes and today are one of the cheapest and most widely used types of contacting apparatus for liquid-liquid extraction, absorption, stripping and distillation. Such a column consists essentially of a vertical shell, filled with packing to promote turbulence between the phases and give a large surface area of contact, over which one of the phases is dispersed in a thin layer.

Stedman[3] in surveying the general requirements of an efficient packing has emphasised the importance of controlled liquid flow, and the avoidance of random flow with its usual accompaniment of channelling. Desirable packing properties can be summarised as follows:

(1) High active surface area per unit volume.
(2) High percentage of free space.
(3) Irregularities in shape to prevent pattern formation.
(4) Good liquid distribution properties.
(5) Low liquid holdup.
(6) Low pressure drop.
(7) Low density and high strength.
(8) Resistance against corrosion and chemicals.

The first four properties are required for minimum of channelling and the maximum efficiency; the latter properties are usually required for specific processes and are related to the cost of a process. One important specific property is the need for a high-efficiency packing with the minimum pressure drop for reduced-pressure distillation. A low pressure drop per theoretical plate is particularly essential when heat-sensitive materials are fractionated under vacuum. To achieve this, gauze packings have been developed which possess a high efficiency and a low pressure drop compared with other types of packing.

Ring packings such as Raschig, partition (Lessing type) and spiral are the most widely used types of packing. Owing to their comparative cheapness, these packings are the most investigated. The bulk of data in the literature concerning packed columns, and in particular the study of liquid distribution characteristics, pertains to ring packings. Ring packings are made of porcelain, chemical stoneware and carbon as well as of steel and other metal alloys by extrusion or punch die techniques. Nominal sizes range from $\frac{1}{8}$ in. to 3 in. Smaller packings up to 2 in. are generally dumped into the tower, while larger sizes are usually stacked.

It is proposed to briefly consider the liquid distribution properties of ring packings and then to survey the main features of gauze packings. Various packings are compared in terms of the pressure drop per theoretical plate. This method of comparison is thought to be important for selecting the best type of packing for low-pressure distillation.

Liquid distribution

The importance of a uniform liquid distribution is emphasised by Baker *et al.*[4] Kirschbaum[5] was one of the first investigators of liquid distribution in packed rectification columns. The apparatus was 4 m. in height and 110 mm. in diameter, using two sizes of porcelain Raschig rings (8 mm. and 15 mm.). Kirschbaum's experiments showed a spread of liquid to the walls of the column. With larger rings the distribution becomes more irregular with marked increase of liquid flow at the walls. Scott[6] verified the effect

of column height, diameter and packing size on channelling and wall flow and explained these results by means of some interesting probability experiments. Scott's apparatus for these latter experiments was a modification of the Galton apparatus, designed by Pearson.[7] A triangular glass panel on a wooden framework was used, with a series of wooden strips which could be adjusted in different lateral positions. A row of wooden triangular obstructions was fastened to these strips so that by sliding the strips different arrangements of obstruction were possible. A hopper was provided at the top of the framework into which a charge of lead shot was placed. If this apparatus is compared with a vertical slice of packed tower taken through the tower axis, the results of the probability experiments show the analogy between the flow of lead shots over obstructions and the flow of liquid down a packed tower and furnish some explanation of the spreading of the liquid to the walls. It was also concluded that the spread of liquid to the walls of the column increases with increasing height of the packed section up to a certain height and then remains practically constant. In fact, with smaller packing a 'reversal' takes place, showing less liquid at the wall than at the intermediate zones.

Maldistribution problem

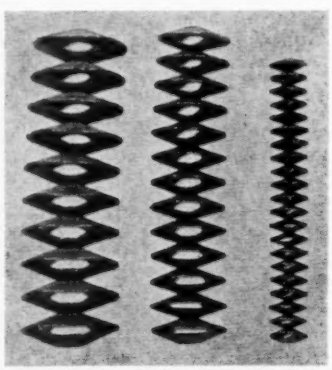
One reason for the wall flow in ring-packed columns is the orientation of rings at the wall of the column. Scott[6] showed that with $\frac{1}{2}$-in. rings 78% of the rings at the wall of the column were positioned with their axes either parallel or at right-angles to the wall. To prevent this pattern formation at the walls and consequently to reduce the wall flow, Kirschbaum[8] suggested replacing the smooth wall of the column by a corrugated wall. This method, although effective, is restricted by the increased cost due to difficulties in fabrication.

The theoretical effect of maldistribution on the fractionating efficiency of packed columns has been the subject of some recent papers.[9–11] Mullin[10] and Manning and Cannon[11] showed that maldistribution is particularly serious when the ratio of the slopes of the equilibrium and operating lines at any point, *i.e.* $m\,G/L$, is greater than unity, and when the relative volatility is more than 1.07. For instance, for systems with a relative volatility of 1.07, 5% channelling of the reflux can, in theory, reduce the number of theoretical plates in the column from 100 to 15.

Wetting characteristics

Another important factor affecting the efficiency of operation of a packed column is the effective wetting of the surface of the packing. In the definition of mass transfer capacity coefficient, $K_G a$, the term a represents the actively wetted surface area per unit volume of packing, which can only be a fraction of the total surface area of the packing. There is no direct proportionality between the total area and the effective area, because the value of a varies with the type and size of the packing, as well as the liquid and gas rates employed. Grimley,[12] using an electrical resistance method and a random ring packing, confirmed that complete wetting was not achieved. Direct measurement of the extent of wetting of the packing has been made by Mayo *et al.*[13] by means of an ingenious experimental technique. A 3-in. column, the inside of which was lined with paper, was used, and the column was filled with $\frac{1}{2}$-in. paper rings to a height of 4 ft. A bright-red dye was added to the water to give a solution which would stain paper a light-red colour. They found that, even with an efficient distributor on the top of the packing, only 40% of the available surface area was wetted after a depth of 1 ft. from the top of the column. Of this wetted area, 10% was still inactive, owing to the formation of stagnant liquid films at points of contact between the packing elements.

Mayo *et al.*[13] also obtained the average film thickness by a consideration of the holdup and wetted surface area. They found that the film thickness increased with increasing liquid rate until a certain thickness was formed which remained essentially constant with further increase of the liquid rate. Pratt[14] has recently shown that, in a gas-film controlled process, the apparent mass-transfer coefficient based on the total packing surface increased rapidly with liquid rate until a critical value was reached, above which it increased only very slowly or remained substantially constant. This critical liquid rate is termed the 'minimum effective liquid rate' (M.E.L.R.) and it corresponds to the lowest rate at which the greatest degree of wetting is obtained.



Courtesy: American Institute of Chemical Engineers and Prof. F. Morton

Fig. 1. Three sizes of conical-type Stedman packing.

At low and high boil-up rates the efficiency can decrease due to the inconsistency of the effective surface area as the throughput is varied.[13, 15, 16] An extensive investigation was carried out by Fenske and co-workers[17–21] to study the performance of random-packed columns. It was found that the efficiency was improved when the packing was initially thoroughly wetted or preflooded. There was a marked decrease in efficiency with increase in packing size.

Development of gauze packing

In 1931, studying the fractionation of close boiling-point mixtures under vacuum, Palkin[22] used gauze trays made of 40-mesh nickel wire for the first time for vapour liquid contacting. These new trays possessed the advantages of simplicity of construction and resistance to flooding and gave a low pressure drop.

During this period the development emphasis was directed towards achieving the maximum surface area and no attempt was made to achieve a controlled and reproducible flow of both liquid and vapour until 1937 when Stedman[23] produced a classic paper which introduced his cellular gauze packing and laid the foundation of controlled flow packings. Stedman's work was a great advance in this field, as he designed a unit packing which possessed the following requirements:

(*a*) Maximum contact area, consistent with low holdup and pressure drop.
(*b*) Good mixing in both phases.
(*c*) Effective mixing in each phase to give a controlled and reproducible flow pattern.
(*d*) Even distribution of both phases across the column cross-section.

Since then, the development of gauze packing can be classified into two groups, although there is no sharp line of demarcation between the two groupings:

(1) Packings made of single wire gauze or perforated metals. Pressure drop in this type of packing is comparatively low due to a high voidage fraction and a good internal liquid

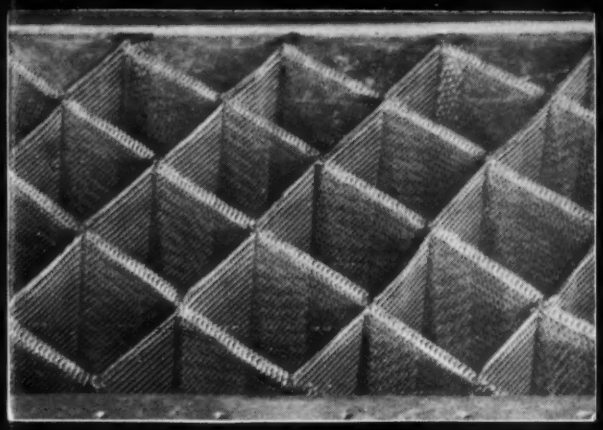
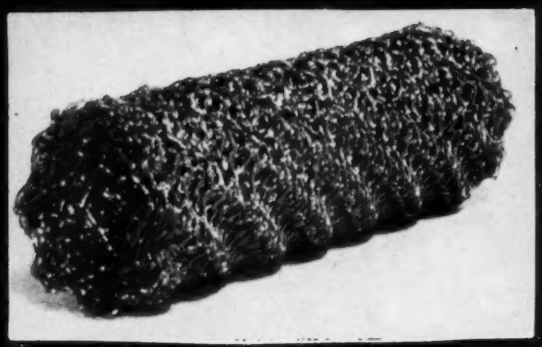


Fig. 2 (*left*). Section of a 15 in. × 27 in. 'Spraypak' tower.

Fig. 3 (*below*). 'Knitmesh Multifil' packing.



distribution over the packing. The following packings may be included in this type: Jack chain,[24] Lecky-Ewell,[25] *Heligrade*,[26] Dixon rings,[27] Stedman,[28, 29] and helical packing,[30] all of which are made of single wire gauze, and McMahon,[31] Cannon protruded,[32] *Panapak*[33] and *Spraypak*,[34, 35] which are made of perforated or expanded metals.

(2) Packings made of a multitude of wires, in which capillary action is one of the determining characteristics. In this group may be included: metal knit cloth,[36, 37] *Yorkmesh*,[38] double corrugated gauze[39, 40] and the Goodloe packing.[41]

Details of some gauze packings

Two main advantages of gauze packing over the conventional random packings are:

(*a*) lower pressure drop due to higher voidage fraction, and

(*b*) increased efficiency due to better internal distribution of liquid and vapour phases and in particular decrease in wall flow, which is as previously mentioned a serious and a common form of channelling in random packings.

To obtain a better picture of the hydraulic behaviour of gauze packings, some construction details will now be considered.

Stedman packings are made to different designs to suit column sizes from $\frac{3}{8}$-in. diam. and greater. In the smaller sizes they are constructed in the single-cell conical type (Fig. 1). This type is generally made of stainless-steel wire cloth which has been embossed and trimmed into flat, truncated, conical discs. A semi-circular hole is cut out on one side of the disc and discs are welded together to form a regular series of cells. The holes which serve as vapour passageways are located alternately on opposite sides of the section. In operation, reflux liquid flows along the wire cloth and seals the openings of the mesh. The liquid flows out towards the walls of the column with a cone that is concave downwards, and then back towards the centre of the column as the cone is concave upwards. The vapour flows through the space between these two cones and out through the vapour opening in the upper cone of the pair. For larger sizes, triangular pyramid and hexagonal types are used. The mechanism of liquid flow and redistribution is as before, and liquid runs down over the mesh and not through it.

Panapak is typical of packings made of expanded metal and is used in large columns ranging from near 2 ft. in diam. *Spraypak*, developed recently, is similar to *Panapak* and so far the only published results are those obtained with a rectangular column 15 in. × 27 in.; these are shown in Fig. 7. A section of such a column is shown in Fig. 2. *Panapak* is composed of a number of metal laths, compacted and bent into V shape. The trays thus formed are placed with the apexes of one layer touching the apexes of the layers above and below to make a honeycomb-like assembly. In this way the liquid will flow down to adjacent slopes, meet at the bottom, redivide on the next slope, etc. The many open sections function in equalising pressures across the tower and establish the controlled and uniform flow pattern, which is required for the efficient functioning of packing, particularly in large-diameter columns.

There is a sizeable gap between the operating characteristics of *Panapak* and Stedman. *Panapak* has a capacity approximately four times that of Stedman and a fractionating efficiency of 0.7 theoretical plate/ft., compared with 3.5 to 4.5 theoretical plate for Stedman. To bridge this gap, Goodloe packing has recently been devised with intermediate characteristics and a comparatively low pressure drop.

Goodloe packing is made of 0.0045-in.-diam. *Monel* wires with 12 filaments, twisted together to form a strand. This strand is knitted to form a tube, which is then flattened to make a double-thickness ribbon. The ribbon is crimped in a 60° angle to the centre and then two of them are arranged in reverse relationship so that the creases cross each other and thereby determine the spacing of the adjacent ribbons. The two ribbons are rolled together until a cartridge is formed having enough layers to provide a diameter to fit the column. A *Knitmesh Multifil* packing which is similar in structure to Goodloe packing is shown in Fig. 3.

The open structure that results from the knitting and the spacing of the creases, provides tortuous passageways for the vapour, resulting in continuous division and recombination of the vapour streams and so promoting effective mixing. The bunch wires are of a capillary nature and provide multiple tortuous channels for the flow of the liquid. These channels are in repeated contact with others, where the

bunch wires cross, and so providing effective mixing of the liquid streams. Also, as the cartridges are firmly held in the column, the capillary action of the wires redistributes the liquid from the walls into the packing.

Preflooding

It has been observed that gauze packings are more efficient if they are completely wetted or flooded prior to a run. According to Carney,[42] the increase in efficiency with pre-flooding is a characteristic of metal packings; a preliminary film of liquid on the packing is probably necessary in order to obtain a uniform flow and an even distribution of reflux. In fact, the high efficiency of Dixon rings[27] is dependent on an elaborate flooding technique. However, there are some exceptions, in which the reported data indicates no change of efficiency on preflooding. In the case of double corrugated gauze packing[40] the numerous capillary passages formed between the two gauze sheets serve to distribute a single stream of reflux over the entire surface of the packing. The performance of Cannon protruded[32] is also claimed to be unaltered by preflooding. The holes in the packing are protrusions which cause the liquid to wet the packing.

Pressure drop per theoretical plate

Raschig rings and gauze packings are compared in terms of pressure drop per theoretical plate. A correlation of pressure drop per theoretical plate for reduced pressures was not possible, due to the lack of reported efficiency and pressure drop data. However, Fig. 4, based on the results of Struck and Kinney[43] for $\frac{1}{4}$-in. carbon Raschig ring and $\frac{3}{4}$-in.-diam. column, indicates that pressure drop per theoretical plate is appreciably increased at low pressures.

Fig. 5 gives some comparative data for Stedman packings.[29] The pressure drop is expressed in millimetres of water per theoretical plate and is given for three different types of packing with different column diameters. It is observed that the pressure drop per theoretical plate increases appreciably with increase in column diameter for the single-cell conical type of packings, whereas the pressure drop remains substantially constant for other types of Stedman packings. Fig. 6 shows the results for Goodloe packing for different sizes of columns. It is observed that pressure drop per theoretical plate is appreciably higher for smaller columns. This is particularly so at low boil-up rates, whereas at higher boil-up rates values of pressure drop per theoretical plate for varying column diameter approach each other.

A representative curve for different packings is given in Fig. 7. The results are essentially for columns approximately 4 in. in diam., at atmospheric pressure, distilling similar hydrocarbon mixtures. Results for *Spraypak* are from a rectangular tower 15 in. × 27 in. separating heavy water from water. Results for Dixon rings[27] and carbon Raschig rings[21] are for columns with $\frac{3}{4}$ in. and 2 in. diam., respectively.

Conclusions

Gauze packings possess a rather high fractionating efficiency due to the large active surface area per unit volume. They do not suffer from loss of efficiency at higher reflux rates, since the structure of packing ensures that the active surface area remains constant up to flooding. Due to the large voidage fraction for these packings, pressure drops are low; pressure drops per theoretical plate are appreciably lower than that of random ring packings at corresponding flow rates. Because of the low pressure drop per theoretical plate, gauze packings are suitable for low-pressure distillations and particularly at pressures of less than 50 mm. Hg and when heat-sensitive materials are distilled.

Undoubtedly one of the most promising types of packings for columns for distillation at low pressure is the multi-strand type of packing or Goodloe packing. A similar type of packing —*Knitmesh Multifil*—is now available in Britain, and distillation experiments in the authors' department in 33-mm. and 75-mm.-diam. columns at atmospheric and reduced pressures confirm the low-pressure-drop results of the knitted mesh packing.

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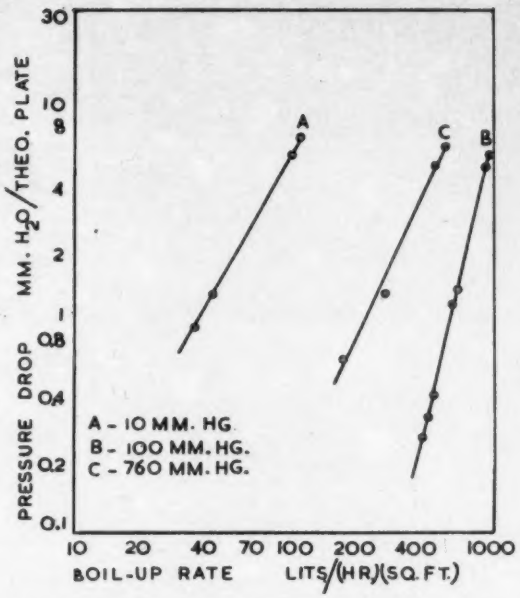
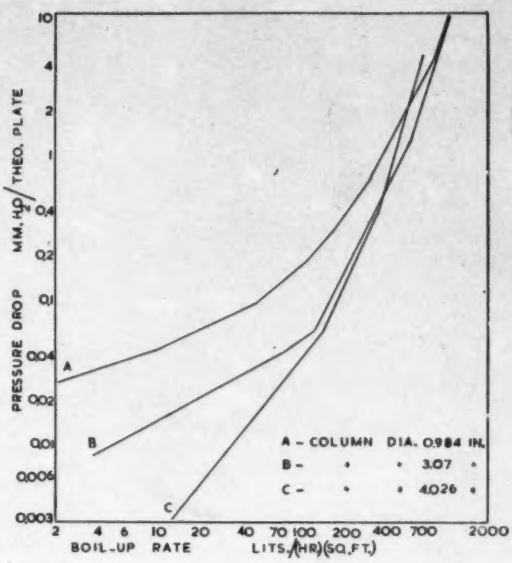
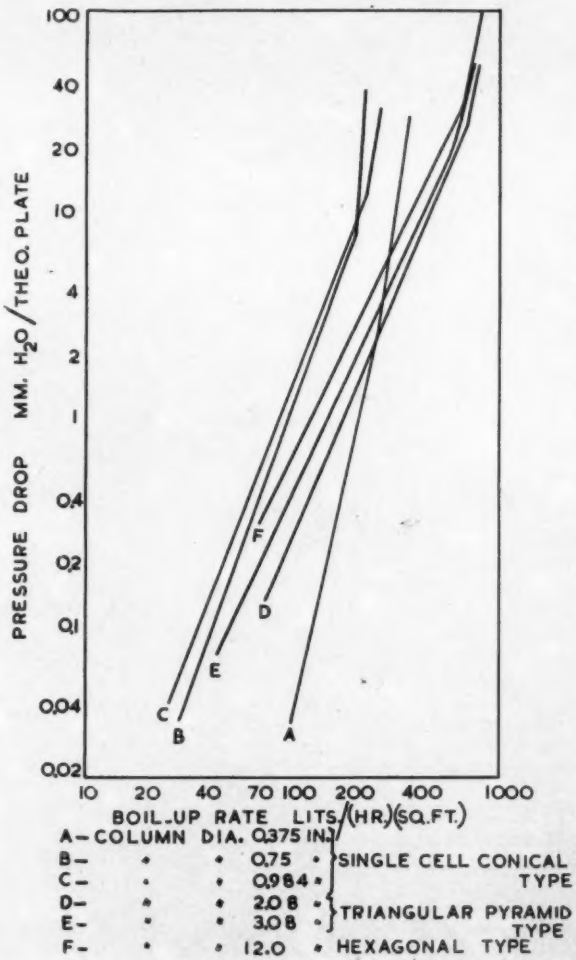






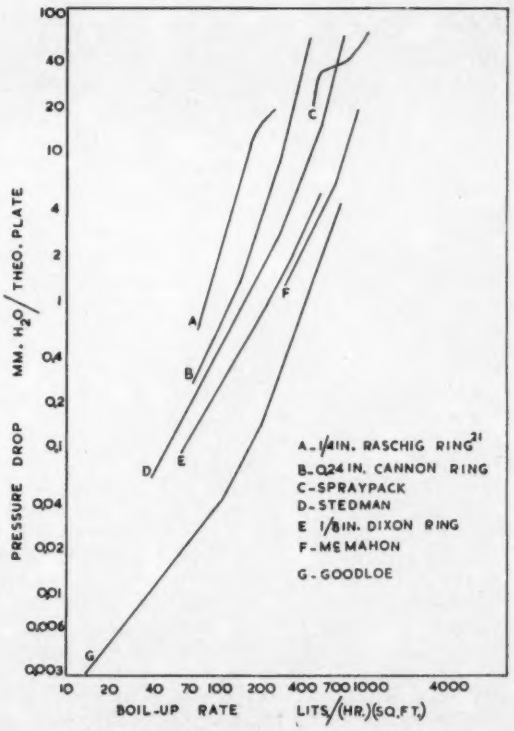


Fig. 4 *(top left)*. **Effect of absolute pressure with ¼-in. Raschig ring.**[43]

Fig. 5 *(bottom left)*. **Pressure drop data for Stedman packings.**[39]

Fig. 6 *(top right)*. **Pressure drop data for Goodloe packing.**

Fig. 7 *(bottom right)*. **A comparison of some common packings.**

Alum solution storage tanks, showing use of polythene piping, in the preparation building of the new board mill.

World's Newest Board Mill

CHEMICAL ENGINEERING FEATURES AT REED PAPER GROUP'S NEW PLANT

A new board mill, built at a cost of £5 million and claimed to be Britain's first complete mill for 25 years, has recently been brought into production by the Reed Paper Group at Colthrop Board & Paper Mills Ltd., Thatcham, Berkshire. In addition to a new board machine which will double the capacity of board produced, the new facilities include some well instrumented process sections and an effluent treatment plant. These features of the mill are described briefly below.

FOUR main types of board are produced in the new mill: white-lined manilla, white-lined chip, cream-lined chip and kraft-lined chip. The board machine itself, which incorporates a high degree of instrumentation, is built to run so that at peak capacity it will produce a continuous highway of board 110 in. wide and some 160 miles long every day.

Stock preparation and cleaning

Raw materials are fed to four *Hydrapulpers* which prepare the stock for the four separate systems which are in use and are arranged for interchange of duties in an emergency.

The main preparatory plant equipment is at first-floor level with the stock chests below, while a second floor covering only part of the main area houses the freshwater and backwater tanks and also tanks for dilute alum solution, 'size' solution and clay mixture, as well as some of the heating and ventilating plant.

Stock cleaning in the case of the 'middles' system is carried out by a battery of *Jumbo Dirtecs* which remove heavy materials and the stock discharges to four *Classifiners* which in turn reject the lighter impurities. The accepted stock is passed to five thickeners or deckers, where the consistency is raised from 0.8% to about 3½%, and the whitewater extracted in this process is returned to the 20-ft. *Hydrapulper* regulating box to dilute the stock before delivery to the *Dirtecs*.

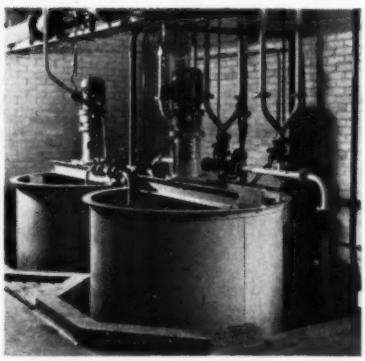
The rejects from the *Classifiners* pass to a disintegrator pump, which is a small, steep-angled conical refiner, and thence to a *Selectrap* from which the accepted stock is passed back into the system for further treatment.

The 'underliner' stock, after initial preparation in the 16-ft. diam. *Hydrapulper*, can either be pumped direct to the unrefined stock chest or it can be diluted to 0.8% consistency for cleaning by *Jumbo Dirtecs* and then thickened as for the 'middles' stock.

The 'backs' stock is pumped from the 14-ft. diam. batch *Hydrapulper* to a storage chest from which it can be treated by a *Hydrafiner* or else the stock can be passed direct to the refiners. A complete duo-cycling system with a central control desk provides the main treatment for the 'liner' stock which is first prepared in the 14-ft. diam. batch-type *Hydrapulper* where a weighed amount of pulp is treated with a metered quantity of water.

The *Hydrafiners* are fitted with automatic plug controls and the interconnecting stainless-steel pipework is so arranged that series or parallel operation can easily be obtained with all or any two of the units.

The remote controls provided allow the operator to set the *Hydrafiner* plug controls so that the units run on predetermined electrical loads, and recording ammeters, as well as depth gauge recorders, give a clear indication of the work done on the stock, while a preset counter automatically controls the number of 'passes' the stock makes through the *Hydrafiners*.



Chemical mixing tanks in the effluent treatment plant.

Duo-cycling chest

The duo-cycling chest is divided by a vertical mid-feather and at the start of each batch treatment one half of the chest is filled with stock at 5½% consistency.

A circulating pump is connected through a valved manifold to each

half of the duo-cycling chest and the 'passes' are effected by the pump emptying one half of the chest and delivering through the *Hydrafiners* to fill the other half. After the requisite number of 'passes' the stock is automatically delivered to the blending chest and a metered quantity of water is added to reduce the consistency to 3% or 3½%. From here the stock is pumped to either one or other of the two 'liner' unrefined chests.

On the ground floor of the preparatory plant building there are 11 reinforced concrete, tile-lined chests. To conserve heat and improve working conditions, all chests are totally enclosed and are situated so that the pipelines to and from the plant above are as short as possible.

Screen-outlet conical mixing hoppers made of stainless steel.

Refining

The final treatment of the four different types of stock is by refining and there are seven Walmsley No. 4 size conical refiners, each direct-coupled to a 250 h.p. motor and driven at 365 r.p.m. The stocks are delivered to a stainless-steel, compartmented distribution headbox at high level from which there is an individual connection to each refiner and this allows a wide variation in the use of these refiners, particularly as they are arranged for operation singly or in series.

In front of the refiner outlet troughs there is a large instrument panel incorporating chest-depth level recorders and consistency regulator recorders, and a control desk for all the pump and agitator motors related to the refining system. The compact arrangement allows quick and easy control of the refining process.

Bank of refiners and stainless-steel outlet trough.

Consistency control equipment provides control and recorders for all four systems before and after refining. In addition, there are consistency indicators for the stock after the 'middles' and 'underliner' thickeners.

Chemical plant

A dissolving plant for aluminium sulphate blocks, situated at ground floor level, comprises three reinforced concrete, asphalt-lined tanks which are served by an overhead electric crane. The concentrated solution is delivered to high-level dilution and storage tanks on the second floor by acid-proof pumps whilst polythene piping is used throughout.

An automatic plant emulsifies concentrated fortified resin size with water and the resulting 5% solution is pumped to high-level storage tanks. Facilities are provided for the continuous addition, by metering, of alum and size solutions to various points in the stock systems.

Board machine

The basement-type board machine has a trimmed width of 110 in. and is designed for a maximum speed of 600 ft./min. The four stocks are delivered to a stainless-steel compartmented headbox directly above eight dual-drive Bird screens. The diluted stock discharges from the Bird screens into separate stainless-steel outlet boxes and then to conical mixing boxes for deaeration and further mixing with whitewater.

Vat section and driers

The stock finally flows from the conical mixing boxes to the machine vat section through stainless-steel or mild-steel *Lithcote*-lined piping into stainless-steel flow spreaders connected to the first upflow passage of each vat.

The vat section comprises eight 48-in. diam. cylinder moulds and vats—six of the 'contraflow' type and two so designed that they can be used for 'contraflow' or 'uniflow' operation.

A further feature of the mill is the drying section, the pre-driers comprising twenty-six 5-ft. diam., steam-heated drying cylinders arranged horizontally in two tiers with a Ross-Grewin vapour absorption system. The whole section is covered by a drier hood with extraction fans discharging to exhaust towers rising above the main roof level.

In the main drier section there are 130 steam-heated drying cylinders each 3 ft. 6 in. in diameter and arranged in eight vertical stacks. A standard cross-tube type of vapour absorption system using fairly high velocity hot air is installed on the stack driers.

For steam raising there are two water-tube boilers of the three-drum,

(*Concluded on page* 250)

TITANIUM

New I.C.I. Plant Speeds Production of 'Tomorrow's Metal'

Things are happening fast in the titanium world. Close upon new developments which increase the usefulness of this metal as a material of construction for chemical and allied plant, I.C.I. have opened a new plant at Waunarlwydd, near Swansea, Glamorgan, which is believed to be the first in the world to be installed solely for the production of wrought titanium. At the same time, the company has announced a further big reduction in the price—between 5 and 20%, depending on the form of wrought product and the grade or alloy of titanium used.

Feeding bar to Robertson rod-rolling mill.

ANNOUNCING the new price reduction to a party of technical press representatives who were entertained at the new Waunarlwydd factory, Mr. P. Hodgkinson, titanium sales manager of Imperial Chemical Industries Ltd., pointed out that, at present, I.C.I. wrought sheet sells at about £6/lb. and rod at about £5/lb. Although, even with the reduction now announced, titanium is more costly than conventional structural metals, there are many instances where its properties may permit the redesign of plant or equipment to reduce its size, and in this way such equipment in titanium would compare very favourably in price with equipment made from conventional materials.

It was plain from Mr. Hodgkinson's remarks that I.C.I. are going all out to bring the price of titanium down still further and to make sure that the quality that makes it most attractive for uses outside the aircraft industry —its corrosion resistance—is fully exploited. I.C.I. now have a strong development team, headed by Dr. K. W. J. Bowen, to develop such uses.

Two recent research discoveries which have greatly enhanced the part which titanium will play in the field of corrosion resistance are: (1) That the principle of anodic polarisation could be applied to titanium (see CHEMICAL & PROCESS ENGINEERING, 1958, **39** (6), 190); and (2) titanium's usefulness as an electrode material. Both these developments are briefly discussed in the ensuing article on 'Chemical Engineering Applications of Titanium' by B. J. Connolly.

Progress in titanium lining has been rapid and the technique has now advanced to the stage when, shortly, an ammonium chloride drier measuring some 40 ft. long × 5 ft. diam. will be lined on site.

One of the very successful chemical applications of massive titanium, Mr. Hodgkinson reported, was a plate-type heat exchanger marketed by A.P.V. By using a special soft grade of sheet, no trouble is met in forming the plates and at this stage of its development the heat exchanger in titanium presents no more problems in manufacture than in the more conventional materials.

The advent of titanium, and particularly of anodically polarised titanium, has made possible a number of chemical processes which previously could not be carried out on a production scale for lack of a suitable material of construction. But the growing use of titanium outside the aircraft industry is not confined to the chemical industry; there is a wide range of use and potential use for such diverse applications as bleaching and paper pulp manufacturing equipment, internal fixation (in the human body), overhead installations in the railway electrification scheme, and in the extensive field of cathodic protection.

The new plant

For rod production, starting stock is 5 in. square or 6 in. diam. round forged billets up to 150 lb. in weight, forged from ingot in the I.C.I. melting plant at the Witton (Birmingham) plant. These are preheated in one of two electric preheat furnaces, with walking beam conveyors, and passed to the first of a two-stand, three-high mill train. At this stand the billets are cogged down to about 2½ in. square, cooled, cut, and then reheated

for further intermediate rolling to a size suitable for passing to the finishing mill train. From the rod mill the material is either passed as straight lengths to the reelers and the cooling beds or it is coiled. In the finishing building rod is cut to finished length and centreless ground or centreless turned to fine tolerances for dispatch.

Sheet production

For producing C.P. sheet, 800-lb. slabs are rolled on a hot strip mill at the Witton plant to strips nominally 24 in. wide by 0.2 in. thickness. These are transported to Waunarlwydd by road and in this plant the strips are cut to sheet blanks for further rolling against individual customer's orders. After initial descaling and dressing the blanks are cold-rolled to gauge with appropriate intermediate anneals.

Annealing is carried out in a continuous-disc, roller-hearth furnace, one of the few of its kind. Material coming from this furnace is exceptionally flat and the even thickness of oxide is more easily and evenly removed.

Descaling and pickling at various stages are done in a separate pickling department, where there are a series of tanks of hydrofluoric, nitric and hydrochloric acid mixtures. The process includes a chemical scale modification treatment which enables the oxide to be more readily removed by acid pickling. There is also some mechanical descaling equipment for alloy sheet.

Titanium 317 alloy, which is the commonest alloy now produced at Waunarlwydd, cannot be cold-rolled economically on single-sheet plant; it is therefore hot-rolled all the way to finished gauge. For this purpose I.C.I. have installed a Sack four-high mill, fed from four sheet preheating furnaces.

Chemical Engineering Applications of Titanium

By B. J. Connolly, B.Sc., A.I.M.

(Development Officer, I.C.I. Metals Division)

The increased availability and lower price of titanium intensifies interest in this metal as a material of construction for chemical plant. Chemical engineers will want to know more about what has been achieved with titanium so far and how it compares with other materials from the point of view of corrosion resistance and cost. Here is a special summary for C.P.E. readers.

So far the bulk of titanium produced in Britain has been used for aircraft applications where a high strength-to-weight ratio is necessary for structural members, but recently more emphasis has been placed on those applications for titanium where corrosion resistance is of prime importance, *e.g.* in chemical plant. The recent installation at I.C.I. Metals Division of three new vacuum melting furnaces now makes possible the production of titanium ingots weighing approximately 2 tons, and from such ingots all wrought forms can be produced, *viz.* billet and slab, rod, bar, wire, extruded sections, plate, sheet, strip and tube.

Provided that certain simple precautions are taken, titanium is as easy to machine as austenitic stainless steel, and its weldability is considered to be better than that of most highly corrosion-resistant materials. Fusion welding is done by the *Argonarc* process and the whole of the weld area must be shielded with argon. Strict cleanliness of the components to be welded must be maintained.

Corrosion resistance

One of the outstanding properties of titanium is its resistance to corrosion by a wide variety of aggressive chemical media, and this property is now being fully exploited to make economic use of the metal for chemical plant equipment.

One of the advantages of titanium over stainless steel and other corrosion-resistant materials is its remarkable resistance to pitting, stress-corrosion cracking and corrosion-fatigue in chloride solutions. The metal is almost immune from attack by sea-water,[1] brine and most other metal chlorides, sodium chlorite and hypochlorite solutions, wet chlorine gas, chlorine dioxide, chromic acid, sulphides, etc., all of which cause rapid attack of stainless steels.

Until very recently it has not been possible, owing to high rates of corrosion, to use titanium equipment for handling moderate and high strengths of sulphuric, hydrochloric, phosphoric, oxalic and formic acids, but a recent discovery in the research department of I.C.I. Metals Division now makes the use of plant in contact with these acids a practical proposition. By applying an impressed voltage to the titanium equipment, which is made the anode of the cell, it has been con-

Courtesy: The Royal Dutch Shell Group of Companies

Fig. 1. Steel reactor vessel with branch pipes, lined throughout with I.C.I. titanium by Marston Excelsior Ltd.

clusively shown that the corrosion is reduced to a tolerable level.[2] This is a manifestation of the principle of anodic polarisation which renders titanium passive to the media mentioned. The same principle can be applied to other materials, but in such cases the applied voltage range over which the protection is afforded is very narrow so that expensive monitoring equipment, in the form of a potentiostat, is required to control the voltage accurately within the narrow limits. In the case of titanium, the voltage range is very wide indeed so that no such equipment is necessary. The power required to maintain protection is extremely small, and to quote a particular example, the corrosion rate of titanium in 40% w/w sulphuric acid at 60°C. is reduced from 1 in. per annum in the unprotected state to less than 0.0001 in. p.a. by the application of considerably less than 100 watts per 1,000 sq. ft.

Another discovery concerns the use of titanium as an electrode material, particularly as an anode, for industrial cells for the manufacture of chemicals, for electro-plating, electro-reduction, electro-descaling and electro-dialysis processes, and also for cathodic protection. If titanium is made the anode in a cell in which the electrolyte is, for example, sea-water, rapid polarisation occurs owing to thickening of the oxide film on the surface, and the metal becomes non-conducting. Raising the voltage in an effort to force the passage of current through the anode merely results in the production of local areas of high current density at points of weakness in the oxide film, and savage pitting of the metal occurs. If the surface of the titanium is coated with an extremely thin layer of a more electro-positive metal, *e.g.* platinum or one of the platinum group of metals, the basis material acts as the main conductor of electricity and the current escapes through the platinum into the electrolyte. With this combination of titanium and platinum, very high anodic current densities can be employed without breakdown of the anode material.

It has been shown that a coating of platinum only 5×10^{-6} in. thick on the surface of titanium can withstand a current density of 300 amp./sq. ft. in sea-water, whereas conventional anode materials such as carbon and lead break down at current densities above about 15-20 amp./sq. ft. However, information is available to support the view that platinised titanium may withstand much higher current densities than 300 amp./sq. ft. It should be noted that the platinum coating need not be continuous.

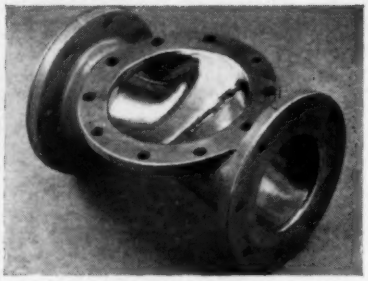


Fig. 2. A 6-in., cast-iron valve body, lined throughout with I.C.I. titanium. Fabricated by Marston Excelsior Ltd. in collaboration with Saunders Valve Co. Ltd.

Fig. 3. Welded pump impeller in I.C.I. titanium. Fabricated by Marston Excelsior Ltd. in collaboration with L. A. Mitchell Ltd.

Fig. 4. Welded pump impeller in I.C.I. titanium. Fabricated by Marston Excelsior Ltd. in collaboration with British LaBour Pump Co. Ltd.

The above-mentioned discoveries provide the engineer with the basis of new ideas for handling aggressive corrodents which hitherto have presented serious problems. In certain instances the advent of titanium has made possible various chemical processes which hitherto could not be carried out on a production scale because of the lack of a suitable material of construction.

Fabrication

Partly because of the high cost of titanium relative to conventional materials, and partly because of its superlative corrosion resistance, thus making a corrosion allowance often unnecessary, the main use of the metal in fabricated plant to date has been in the form of thin (*e.g.* 20 s.w.g.) sheet linings inside mild-steel or cast-iron vessels. Direct fusion welding of titanium to mild steel is not advisable because of the formation of a brittle intermetallic layer, but methods employing spot welding techniques have been devised for attaching linings to the wall of steel vessels.

Complicated vessels incorporating branch pipes, etc., can be lined successfully (see Fig. 1) and intricate shapes such as valves of the type shown in Fig. 2 can be lined with titanium. Thermo-pockets, stirrers, heating and cooling coils, nozzles, etc., can all be made by welding up sheet and tube, or by machining from the solid, and ancillary equipment such as expanded metal mesh, woven wire mesh, and perforated filter plates have been manufactured. Figs. 3 and 4 illustrate two types of pump impeller which have been fabricated by welding. Fig. 5 shows a high-pressure valve machined from solid titanium alloy bar.

Examples of titanium equipment

Already titanium is proving itself to be commercially justified, even at present prices, and in several instances has outlasted previous materials by a wide margin, thus reducing maintenance costs and avoiding costly down-time of the plant. Two such examples are gas/water nozzles, which were previously made of silicon iron, handling sea-water saturated with sulphur dioxide and operating in hot gas containing sulphur dioxide, and gas compressor valve plates and springs where corrosion-fatigue caused early failure of low-alloy and stainless steels. In the case of the valve springs, which were made from hard-drawn

Table I. Typical Prices of Titanium-lined and Stainless-steel Vessels

	*Approx. price for titanium-lined vessels**		*Approx. price for ⅜ in. stainless-steel vessels**
		£	£
Plain rectangular open-topped tank 9 ft. 6 in. × 3 ft. 6 in. × 3 ft. 6 in. (excluding flanges, branches, etc.)	20 s.w.g. titanium lining	1,100	475
	⅜ in. mild-steel vessel ..	85	
	Total ..	1,185	
Open-topped cylindrical vat 5 ft. diam. × 6 ft. deep with domed bottom (excluding flanges, branches, etc.)	20 s.w.g. titanium lining	1,150	500
	⅜ in. mild-steel vessel ..	120	
	Total ..	1,270	

* These prices include the cost of the material and the cost of fabrication.

Fig. 5. A ¼-in.-bore, high-pressure needle valve in I.C.I. titanium alloy, made for handling a variety of corrosive gases. After six weeks' service, opening and closing every two hours, it was in excellent condition. Made by Ashford Components Ltd., London.

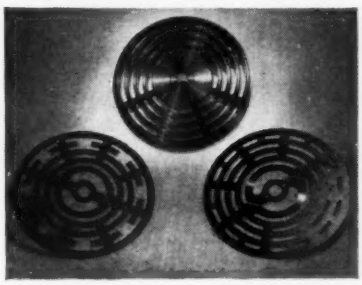


Fig. 6. Hoerbiger-type compressor valve assembly, showing valve plate and damper plate (*bottom*) in I.C.I. titanium alloy, and valve seat (*top*) in I.C.I. commercially pure titanium. Made by Compressor Accessories Ltd.

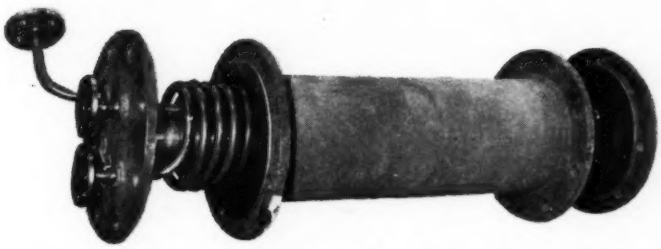


Fig. 7. Titanium-lined vessel with titanium cooling coil. Fabrication by Marston Excelsior Ltd.

titanium alloy wire, no failures have occurred in several thousand hours, whereas several failures are usually experienced within the same time with carbon spring steel and stainless steel. Valve plates of the type shown in Fig. 6 are being installed in compressors in a number of plants.

There is interest in plate-type heat exchangers fabricated in titanium for recovering waste heat from certain corrosive chemical plant effluents. A tube-in-shell heat exchanger incorporating titanium has shown no sign of attack after almost two years in 60% nitric acid at 250°C. and 300 p.s.i. pressure,[3] whereas stainless steel lasted only six months.

A number of chemical plant vessels, including reactors, condensers, coolers, etc. (see Fig. 7), have been fabricated either wholly in titanium or from titanium-lined mild steel.

As an indication of the present state of fabrication techniques, a large rotary drier, 40 ft. long × 5 ft. diam. handling damp ammonium chloride crystals, has been lined on site with thin titanium sheet. Previously severe pitting was experienced with a stainless-steel lining, but titanium has been shown to resist this form of attack completely when in contact with ammonium chloride.

A battery of agitator units incorporating titanium shafts running in glass-impregnated *Fluon* has been in service for over six months handling organic acids. This equipment has not given the slightest trouble. A 2-in. wedge-gate valve of duplex mild-steel/titanium construction has been put into service in a particularly noxious mixture of trichlorethylene, hydrochloric acid and chlorine. All parts of the valve in contact with the corrodent are in titanium, and mild-steel backing is provided for these parts to reduce the cost.

Titanium is completely resistant to normal chromium-plating solutions and several heating coils for such service have been made. Tank linings, thermostat sheaths and platinised titanium electrodes are also likely to be required.

In the photographic industry, titanium is likely to find a wide use because of its resistance to, and lack of effect on, emulsions. A small emulsion container has been fabricated in titanium, and other equipment is being considered.

It has been well established that titanium is completely resistant to sodium chlorite, hypochlorite and chlorine dioxide which are used in textile and paper and wood pulp bleaching. A titanium-lined chlorine dioxide mixer for a paper pulp mill has given excellent service over a period of approximately two years in America.[4] A titanium tube-in-shell heat exchanger was found to be in excellent condition after a similar time in 15% sodium hypochlorite solution. Textile bleaching equipment incorporating titanium is under consideration in this country.

The advantages of using titanium for the tips of anodising jigs and racks has been established for some years and several all-titanium racks are in existence in Britain and America. When current is passed, an insulating anodic film rapidly builds up on the surface of titanium in anodising solutions, but as soon as another metal is brought into contact with it, the film becomes conducting. This property of titanium, which is unique among

materials used for this purpose, enables racks made in the metal to last many times the life of conventional components, with the added advantage that no stripping operation is necessary.

The foregoing describes but a few of the instances where titanium components are already in service. There are numerous other applications for which designs incorporating titanium are being prepared or considered, or for which prototypes are being constructed. These include equipment for handling chlorine in aqueous solution, tank linings for the chemical and allied industries and large chemical reaction vessels.

Costs

In order to give some idea of the cost of lining mild-steel equipment with titanium sheet, typical present-day prices are indicated in Table 1. Up-to-date prices for equipment of the same size made wholly in stainless steel are included for comparison.

Although the initial cost of titanium-lined equipment may be higher than that of usual materials of construction, the saving in maintenance costs and lost-time production, which can be achieved over a period of time, can more than offset this higher cost. This has already proved to be the case in several applications within the chemical industry.

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[2] J. B. Cotton, *Chem. & Ind.*, 1958, (3), 68-69.
[3] W. E. Lusby, *Corrosion*, 1957, **13** (10), 654t-658t.
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World's Newest Board Mill

(*Concluded from page 245*)

vertical-tube type with integral steam receiver between the boiler drum and the superheater inlet.

The feedwater treatment plant comprises a single lime reaction tank in which the raw water is pretreated by hot lime process; three pressure filters and three zeolite tanks provide after-treatment to give zero hardness. The whole feedwater supply to the feed pumps is passed through a Weir deaerator.

The effluent from the mill is passed to a clarification plant consisting of two 50-ft. diam. *Clariflocculator* tanks with rotating scraper mechanism, the plant being capable of handling 600,000 gal./day. The clarified water is then pumped to percolating filters for further treatment before being returned to the canal from which the mill draws its supplies of water for production and power generation.

Equipment suppliers

Among the suppliers of equipment for the mill were Black-Clawson International (*Hydrapulpers, Hydrafiners, etc.*); Vickerys Ltd. (*Dirtecs*); Dorr-Oliver (*Clariflocculators*, etc.); Evershed & Vignoles Ltd., Elliott Brothers (London) Ltd. and Taylor Controls Ltd. (instrumentation); Hackbridge & Hewittic Electric Co. Ltd. (electrical equipment); Neckar Water Softener Co. (feedwater treatment plant); Watford Engineering (thickeners); Broom & Wade Ltd., S. H. Johnson & Co. Ltd., L. A. Mitchell Ltd., Premier Colloid Mills Ltd., and many others.

Elastomers Research

An elastomers research laboratory is to be built at Hemel Hempstead, Hertfordshire, by the Du Pont Co. (United Kingdom) Ltd. The new laboratory will duplicate mill equipment and conditions found in the British rubber processing industry, and much research will be directed at solving problems of individual plants. It will include compounding, processing, and testing of all types of synthetic rubber compositions and products. The laboratory will be equipped with mills and internal mixers, processing machines such as calenders and extruders, and steam-heated hydraulic presses, autoclaves, and circulating-air ovens for vulcanising.

Special machinery to prepare solutions and water dispersions of *Neoprene* will be provided. Similar equipment will be installed for processing *Hypalon* synthetic rubber—a comparative newcomer among elastomers—*Adiprene* urethane rubber, and the recently developed *Viton* synthetic rubber.

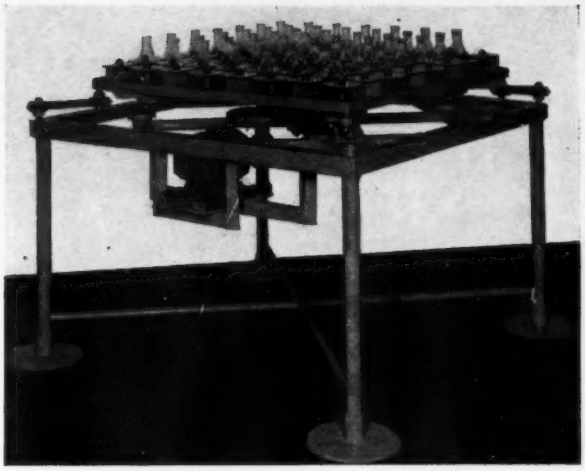
In addition to the mill equipment, machines and devices will be installed to test tensile strength, abrasion resistance, hardness, flex resistance, compression set, and chemical resistance of elastomers and elastomeric compounds, both at the time of manufacture and after ageing under various conditions.

The staff will consist of graduate chemists and chemical engineers—all of whom will receive advanced training in the United States—and they will be assisted by approximately 10 technicians. The latter will receive special training at the laboratory.

C.P.E. AT THE ACHEMA

One of the visitors to our stand at the recent Achema Exhibition in Germany was H.M. Ambassador to Bonn, Sir Christopher Steel. He is seen here signing the visitors' book, watched by Mr. Ernest Hill, C.P.E.'s manager.

Mechanisation of Laboratory Operations



Apex laboratory shaker, described below.

Saving of valuable man-hours by the application of automatic techniques is no less important in the laboratory than in industrial operations. Automatic equipment and apparatus are now available to cover every laboratory need, and some examples are given below.

THE shortage of scientists and skilled technicians emphasises the need to reduce to a minimum the time spent by such personnel in carrying out routine laboratory operations. Whether they be simple mechanical operations or complicated analytical procedures, laboratory activities must yield to an ever-increasing degree of mechanisation and automatic control. In some laboratories improvisation of labour-saving gadgets is resorted to, often to good effect, although there have been cases where the time and effort spent in designing and constructing such devices would seem to outweigh the savings achieved.

Simple mechanical operations are an obvious field for the elimination of much labour, one example being a laboratory shaker, designed by Apex Construction Ltd., which imparts a rotary action to flasks which are mounted on it. The Model 223A shaker is designed to take 49 250-c.c. flasks and is driven by a $\frac{1}{4}$-h.p. motor through a V-belt drive to a pulley mounted centrally on the tubular floor stand. The board which accommodates the flasks is mounted on to this pulley by means of an eccentric mechanism which has an adjustment between $\frac{3}{4}$ and $2\frac{1}{2}$ in. The final speed obtainable on the pulley is 100 or 160 r.p.m. and change of speed is effected by change of motor pulley.

An operation of a rather different sort is carried out by the automatic liquid dispenser produced by Nash & Thompson Ltd. Designed originally for multiple serological titrations, this instrument has possibilities in many other fields of research and production. It consists of 12 pumping units to which ungraduated pipettes may be quickly attached. A simple lever movement is used to inspirate liquid into them and to pipette small volumes (up to 1 ml.) into suitable receiving vessels.

Pumping in the laboratory

Pumps are naturally an important part of laboratory equipment and a great variety of units are available, ranging from simple carboy pumps to large and complicated pumps for specialised duties.

For withdrawing corrosive liquids from carboys and other containers—an awkward and hazardous operation in the early days of chemical industry—E. M. Francis Ltd. have recently brought on to the market their new *Placid* pump which is constructed almost entirely of polythene. Although it operates by means of a rubber bulb, the liquids actually only come into contact with parts made of polythene. The pump can thus be used for the very large range of liquids which have little or no effect on polythene.

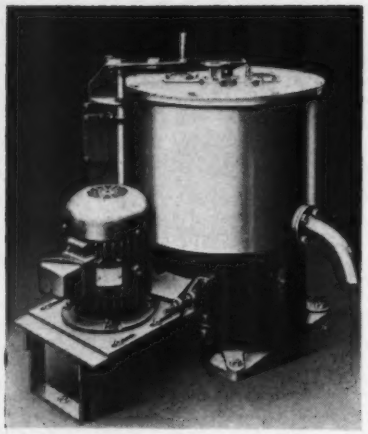
Care has to be exercised, however, in handling concentrated sulphuric acid as, if there is the slightest trace of water left in the pump, the heat generated by the sulphuric acid will destroy it.

The *Placid* pump gives a delivery of 6 to 8 pints/min.

A solenoid-operated plunger pump for automatic titration process, laboratory and similar duties, is produced by E.C.D. Ltd. Capacities range from 5 to 10,000 ml./hr. The stroke is adjustable while running from zero to $\frac{3}{4}$ in., and the speed is adjustable while running from 6 to 60 strokes/min. Provision is made for plug-in automatic speed control.

A useful centrifugal pump for handling acids, alkalis, alcohols and chemically corrosive liquids is produced in PVC by Glen Creston Ltd. This gives a performance of 3 gal./min. at 2-ft. head, 2,800 r.p.m., and a maximum total discharge head of 12 ft. Features include a shaft protected by a removable sleeve of stainless steel and the power required is $\frac{1}{6}$ h.p.

British Thomson Houston Co. Ltd. manufacture a pump



The new Broadbent centrifuge.

which enables a conducting liquid to be circulated by electromagnetic forces developed directly within the liquid, thus eliminating moving parts and the need for glands and seals. For laboratory-scale duty, the single-phase a.c. conduction pump with combined transformer is convenient; it requires no special supplies and, with the use of appropriate tube materials, can handle mercury and bismuth or sodium and the sodium-potassium alloys.

Centrifuging

A new centrifuge with labour-saving features is offered by Broadbent's. It has a mechanical unloading plough discharging through the basket bottom, emptying the basket in a very short time. A hydraulic-drive motor gives three speeds for feeding, drying and discharging. Hydraulic pressure is also used for braking.

A self-balancing, fume-tight cover is fully interlocked so that access to the basket can only be obtained at ploughing speed, or below.

A novel type of centrifuge by Griffin & George has a self-balancing head and a rotating system which includes the bowl as well as the centrifuge head. The motor frame is resiliently mounted to allow a limited lateral freedom of movement to the rotating system, which is free to align itself about the axis of dynamic balance with a resultant relief of side thrust on the motor bearings. No precise static balancing of the centrifuge is necessary.

Another centrifuge with labour-saving attachments is a refrigerated unit by the French firm Etablissements Jouan. This provides speeds of up to 21,000 r.p.m. and a capacity of up to four containers of 500 ml. and 120 serological test tubes. The machine can be provided with an automatic starter which makes it possible to obtain automatically a progressive acceleration until the required speed is attained. This speed control avoids any overcharge of current either on the motor or the rheostat, as well as saving the operator time.

Mixing

Three vibratory mixers recently introduced by Q.V.F. Ltd. are noteworthy for the extremely rapid vertical agitation of horizontal blades immersed in the liquid. They and the shaft on which they are mounted are of stainless steel. A two-way switch on the a.c. motor varies the length of stroke and so alters the mixing action.

Being able to handle quantities from 10 to 3,000 l., these mixers are not by any means confined to laboratory uses, but they are worth mentioning as important time-savers because they accelerate chemical reactions. There are no rotating parts, no stuffing boxes or mercury seals and the agitator is totally enclosed.

The Premier Colloid Mills Ltd. mixer 1300 has a 1/30-h.p. totally-enclosed motor, with variable speed control up to 4,000 r.p.m. incorporated in the machine. The telescopic stand gives vertical and horizontal control and the mixing head, whether *Dispersator*, propeller or cage-breaker, is in stainless steel. The mixer is finished in chrome and acid-resisting stove enamel.

An interesting range of machines available in laboratory sizes are the *Rotocube* dry powder mixers developed by Foster, Yates & Thom Ltd. and comprising a cube-shaped drum mounted diagonally at a compound angle on trunnions and rotated at 10 r.p.m. The resulting action inside the drum prevents the heavier ingredients from accumulating at the bottom of the mix and effects uniform distribution of each constituent, including those that may represent only a minute percentage of the total mix.

A *Uni-rotor* has been built by Baker Perkins Ltd. in collaboration with the British Rubber Producers' Research Association. It has been used for some years in the laboratories of the B.R.P.R.A. to meet the requirements of research studies and the handling of small amounts of experimental materials. Now special mixing chambers have been added to make this machine suitable for small-scale mixing operations.

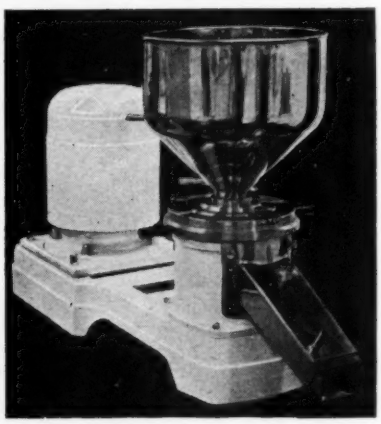
The heavy ingredients are contained in a cup-like chamber and are mixed by a rotating twisted blade. The shape of the rotor and grooving of the chamber urges the material to the closed end of the chamber as well as moving it laterally to give efficient mixing. This arrangement allows up to 1 h.p. input per gramme of material. There is no tendency for materials to escape from the open end of the chamber.

The smallest mixing chamber provides efficient mixing of 2 to 10 g. of material. The next size overlaps this range and operates with up to 50 g. of material. The large variability of charge over a five-fold ratio is one useful feature. Another is the short time, 1 min. or less, required for loading and unloading.

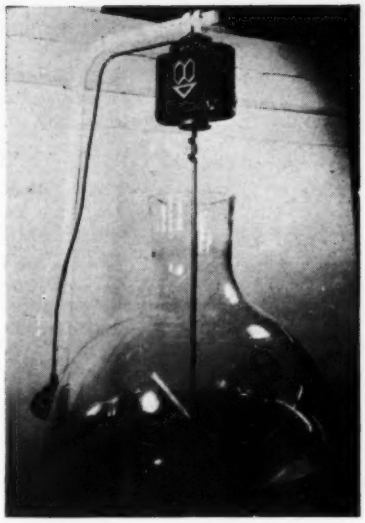
Comminution

A 3-in. bench version as well as a 6-in. production model of a new dispersion mill is being produced by Premier Colloid Mills. These mills have only one moving part, the rotor. Combined with the fact that there is no contact between the shear plates, this keeps wear, maintenance and replacements to the minimum.

It is claimed that solvent losses are negligible with the new Premier dispersion mills, and that the bench unit



New 3-in. dispersion mill by Premier Colloid Mills.



◀ Q.V.F. 'Vibro' mixer working in a 200-litre flask.

▶ Laboratory model separator made by Alfa-Laval Co. Ltd. Alternative covers are available for gas-tight operation.

processes as little as half a pint with only a few grammes waste. The degree of grind is adjustable easily and without tools.

The small unit requires only 3 sq. ft. of bench space and is portable, requiring no further installation than the connection of electrical and water supplies.

The latest addition to the range of Apex comminuting mills, designed for laboratory, pilot-plant and small-scale production, is essentially a smaller version of the No. 114 but with a number of new and improved features.

A few of the most important improvements in the design are that: (1) the standard model has its driving motor slung beneath the base, which permits greater cleanliness and the absence of any dust pockets; (2) the grinding chamber has been designed with vertical end plates which permit the comminuting mill to be used for granulating sticky materials; and (3) the bearings of the grinding chamber are located outboard of the chamber and have been designed with labyrinth-type grease seals. This last feature has eliminated the use of the rubber tyre grease seal and now permits the rotor to be run at much higher speeds.

The 'Ultramatic' single-pan balance.

The No. 214 comminuting mill is normally driven by a 3-h.p. motor and speeds up to 7,000 r.p.m. are standard. The output of the machine is approximately 100 to 200 lb./hr.

The micro hammer mill produced by Glen Creston Ltd. makes possible the rapid pulverisation of materials to the necessary size for analytical work. Its dimensions and construction are aimed at making the crushing, recovery of the ground material and subsequent cleaning of the mill as simple and speedy as possible. Loss of material is reduced to practically nil, since the hinged floor of the small grinding chamber is sealed by rubber gaskets when closed, and the cover and plastic tube fit tightly to the body of the mill.

Particle size can be adjusted by quickly interchangeable screens with mesh of various diameters, while motor speed is regulated by a built-in variable resistance which provides a fine control over the action of the hammers to suit any given material.

Drying and incubation

The drying of liquid or pasty materials by a process of split-second atomisation in a current of warm air is provided for in a laboratory spray drier brought out by George Scott & Son (London) Ltd. One man can handle several units. The atomiser in the Scott spray drier is of the streamlined rotary type, impeller shaped, with wide, non-choking passages, rotating at 6,000 to 12,000 r.p.m. with direct electric drive by special high-speed motor.

The liquid to be dried is pumped under pressure to the drying chamber and flows freely to the atomiser where it is subjected to centrifugal force and broken into a very fine umbrella of spray. The drying medium is warm air which is drawn through the installation by a fan, filtered, heated and supplied to the drying chamber to maintain a predetermined temperature.

Spray and air mix intimately, and the air carries the atomised particles through the plant. The moisture contained in the tiny particles is instantly absorbed by the drying air, and the spray is thus transferred into dry powder before contacting the walls of the drying chamber. Most of the powder drops to the bottom of the chamber. Part of the material, however, is entrained by the air which is passed through a filter in which the powder is recovered

and returned automatically to the main discharge, where it is delivered at one point.

A new range of ovens and incubators by Gallenkamp & Co. makes use of a special hydraulic thermostat known as the *Compenstat*, which is claimed to have a number of advantages where temperature setting is concerned. No relay is required in the control circuit, thus eliminating a possible source of breakdown.

The temperature range of the ovens is up to 200°C., which is reached within 65 min. from room temperature. It is stated that at 100°C. the temperature variation between any two points in the working space does not exceed ±2.5°C., while the fluctuation at any single point is not more than 0.25°C.

The incubators are designed to have a maximum working temperature of 100°C.

In Townson & Mercer's oven with automatic boost heating there is a time-delay relay which brings in extra boost heating whenever the normal heating has been on for more than a short predetermined period. This extra heating is effected by means of a flameproof embedded element actually inside the oven carcase, so that it gives up its heat exceptionally quickly to the high-velocity air flow from the fan circulator.

The automatic boost system is not required in ordinary incubation work, but is of great value where the oven has to be loaded or unloaded at all frequently.

Other laboratory operations

Along with such developments as the foregoing there has been a tendency towards introducing speedier and less laborious methods of weighing, *p*H measurement, viscometry, titrimetry, etc., while the chemist and chemical engineer engaged in research and development has at his disposal some excellent apparatus for carrying out operations involving filtration, distillation, evaporation, ion exchange, etc. These advances, fully made use of, and taking into account also the very real progress that has been made in such fields as chromatography, polarography, spectrophotometry and other modern tools of analysis and control, will ensure the efficient use of scientists in the laboratory.

Contracts

Carbide Industries Ltd. of London (a unit of the chemical division of British Oxygen Co.) have recently awarded to W. J. Fraser & Co. Ltd. a contract for the supply and construction of a complete acetylene gas-producing plant. The plant is being built under licence from the Shawinigan Chemical Co. of Canada and will be installed in Northern Ireland to provide acetylene to an adjacent factory being built by Du Pont (Great Britain) Ltd.

Frasers are also supplying to Du Pont a number of special heat exchangers required for their plant.

★

The chemical plant division of the Power-Gas Corporation Ltd. has obtained an order from Kali-Chemie A.G. of Germany for the supply of a Power-Gas *Hercules* reforming plant. This unit, similar to others erected in the United Kingdom, is based upon liquid hydrocarbon feedstock and comprises a tubular cracking furnace followed by carbon monoxide conversion, carbon dioxide removal and a methanation stage to provide the highest possible purity of the final hydrogen.

★

The new tonnage oxygen plant supplied by British Oxygen Linde, which is being erected at Shell Haven, on the Thames Estuary, by British Oxygen Engineering Ltd., has been completed and is expected to be fully commissioned in August. The plant is designed to produce 240 tons of oxygen and 235 tons of nitrogen a day for the manufacture of ammonia.

Another British Oxygen Linde plant has been built at Partington, Lancashire, for Petrochemicals Ltd., and is capable of supplying 145 tons of oxygen and 55 tons of nitrogen a day. The oxygen will be used for the direct oxidation of ethylene and this plant is also expected to come into service in August.

The combined value of the contracts for these two plants is estimated to be more than £500,000.

★

The chemical division of the Distillers Co. Ltd., which provided the liquid carbon dioxide bulk storage and evaporation equipment for the first commercial atomic power station at Calder Hall, has been responsible for the installation in the new station at Chapel Cross. This includes five thermally insulated bulk storage tanks, each with a capacity of 20 tons of liquid carbon dioxide and with a pressure-operated refrigerator and safety valves, together with six evaporators, each capable of vaporising 3 tons/hr. of liquid carbon dioxide.

★

Matthew Hall & Co. Ltd. have been awarded a contract for the mechanical engineering design of the synthetic rubber plant to be constructed at Pernis refinery, Holland, for the Royal Dutch/Shell Group. This will be Holland's first synthetic rubber plant and will have a capacity of at least 50,000 tons p.a.

The decision to erect this plant has been based on extensive studies of the future world rubber requirements and supply position. Production is expected to commence in 1960.

This is the second large synthetic rubber plant contract awarded to Matthew Hall & Co. Ltd.

★

Scientific Design Co. Inc., U.S.A., has been awarded a contract to design a para-xylene manufacturing plant for Mitsui Petrochemical Industries Ltd., of Tokyo, Japan. The plant will be constructed at Iwakuni City, Japan, and is scheduled to be completed by the summer of 1959. The new plant will be part of the large petrochemical complex Mitsui is now operating.

The plant will employ two processes, under which Mitsui has been licensed by Standard Oil Co. (Indiana) and Atlantic Refining Co., in an integrated operation to produce para-xylene in high yield from ordinary mixed xylenes. Standard's para-xylene separation process will be used to extract para-xylene of high purity from the mixed xylene feedstock. The effluent from the separation unit, consisting primarily of ortho-xylene, meta-xylene and ethyl benzene, will be passed through an isomerisation unit based on Atlantic's *Octafining* process, in which these isomers of para-xylene will be converted to para-xylene. The hydrocarbon stream from the isomerisation unit will be continuously recycled back to the separation system.

The para-xylene product will be used in the manufacture of terephthalic acid, an important intermediate for synthetic textile fibres, in an oxidation plant, also engineered by S.D., which is now under construction at Iwakuni City.

Britain's Biggest-ever Display of Chemical and Petroleum Plant

MORE IMPRESSIONS OF THE CHEMICAL AND PETROLEUM ENGINEERING EXHIBITION

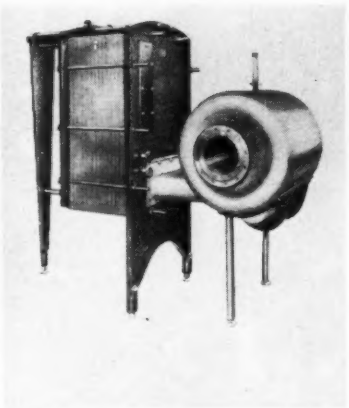
Following our special issue last month on the Chemical and Petroleum Engineering Exhibition, which is still in progress as we go to press, we give below a few further examples of the new plant and equipment brought forth by this unique event.

NEW plant and equipment were displayed at the exhibition in great abundance and only one or two developments can be mentioned here to give some indication of the whole.

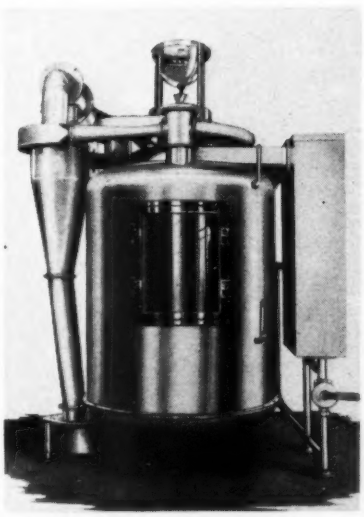
Often on one stand alone there was a wealth of new ideas to arrest the attention; thus on the stand of the **Balfour Group** three companies—Henry Balfour Ltd., George Scott & Son (London) Ltd. and Enamelled Metal Products Corporation (1933) Ltd. — showed interesting exhibits. These included the Scott-Smith molecular still, which separates or purifies high-molecular-weight or heat-sensitive materials under very high vacuum conditions, and the Scott forced-circulation heater—a heat exchanger that achieves a very high rate of heat transfer on difficult chemical liquors. A series of Scott-Willems *Dispersitrons*, for contacting, dispersing, emulsifying, blending and homogenising various liquids and solids, also appeared on this stand. The range of applications includes the making of suspensions, stable emulsions and colloid solutions, the aggregation of gases, liquids and solids or mixtures of all three and the handling of sticky materials.

The Goulds-Pfauldler glassed pump also attracted much notice as an answer to the problem of metallic contamination and corrosion; a glassed-steel autoclave proved of special interest to manufacturers of polymers. The Pfaudler conical glassed-steel drier-blender, which uses a tumbler drying action to produce an extremely homogeneous product is claimed to have a number of advantages including resistance to product adherence, reducing clean-up losses and labour and improving heat transfer. Heat-sensitive materials can be dried under vacuum to enable reduced temperatures to be used.

Films, models and photographs proved no less an attraction than equipment, as on the stand of the



This A.P.V. evaporator is particularly simple and compact and requires only 8 ft. of head room, as plates on the climbing and falling film principle are used instead of tubes.



F. W. Berk Ltd. showed their pilot-plant ring jet spray drier. Centrifugal force and air blast are used together to produce a spray of controllable fineness.

Kellogg International Corporation, which stressed this concern's contributions to the design, engineering and construction of ethylene plants. Kellogg staged the first British showing of the results of their new model-making technique. Through this technique, and through the use of prefabricated plastic components, models of any petroleum or chemical plant can be assembled at the design stage, and no special skills are required. Models are completed concurrently with the engineering designs and can be used for review purposes, at the construction site and as operator training aids.

Doulton Industrial Porcelains Ltd., part of the Royal Doulton group of potteries, introduced a range of porcelain ball mills of completely new design. Constructed from Doulton hard porcelain, they are claimed to be free from corrosion and contamination and to be ideal for wet or dry grinding of paint ingredients, pharmaceutical products and foodstuffs. They are available in 10 sizes from 1 pint to 7 gal. nominal capacity and have a special ground cover and fixing arrangement. A particular feature is that covers are interchangeable without effecting the efficiency of the seal. A pouring spout, which can also be used as a strainer, is available if required.

High-speed ball mills, operating on a planetary motion principle, were displayed by **Steele & Cowlishaw Ltd.** Another exhibit on this stand was the *Oblicone* blender, a unique feature of which is the design of the cones and their oblique or ' offset ' angles imparting a combined gyratory and tumbling motion of the contents at each spin of the drum and the highest possible number of spins per unit of time.

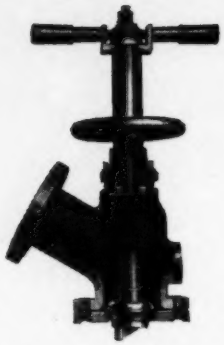
Air Pumps Ltd. were exhibiting for the first time their new rotary, two-stage, oil-flooded, sliding-vane compressors. The company displayed one

of a number which are being supplied to South African Railways for operation in an atmosphere heavily contaminated with rock dust, at 6,000 ft. altitude and 104°F. ambient temperature.

These compressors are designed for either mobile or stationary application and are powered by either internal combustion engines or electric motors, with a range of capacities from 300 up to 600 cu.ft./min. free air delivered to B.S. 726, for working pressures up to 125 p.s.i.g., humidities up to saturation point, altitudes up to 10,000 ft. and ambient temperatures up to 125°F.

The standard, engine-driven compressor models are fitted with single-lever start and stop control, automatic floating speed regulation, automatic mechanical shut-down protection with indicators, cyclonic precleaner oil-bath air inlet filters to B.S. 1701 Grade 'A,' fuel and lubricating oil filters, and heavy-duty undercarriage with automotive steering.

Berk spray driers on view revealed new designs for spray unit, air flow and dried product recovery. A full-size, silent-running, slow-speed ring jet spray unit showed the combined use of centrifugal force and air blast for producing spray of controllable fineness. A fully operating pilot spray drier showed single-point discharge from drying chamber and cyclones achieved through air ejectors.



This downward-closing valve developed by T. & C. Clark & Co. Ltd. was shown at the Exhibition.

The Berk fluid-bed drier has just been brought out, and a glass pilot plant was shown in operation. Application of fluidisation for drying has begun only recently and specialised designs adapted to properties of materials promise interesting developments.

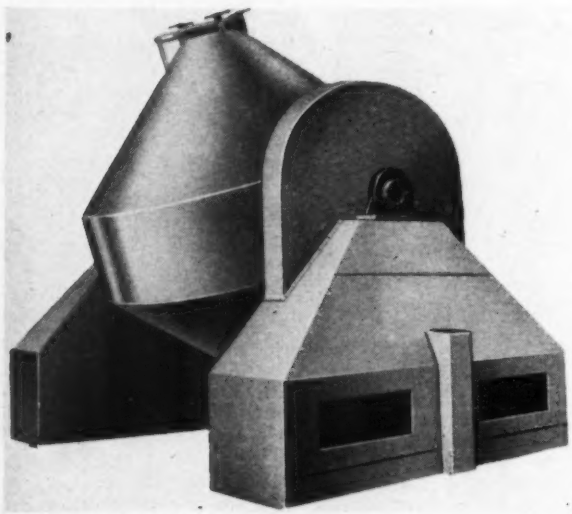
Amongst 'first-time' exhibits on the **Babcock & Wilcox** stand was a production unit of a floating-head-type heat exchanger, as used in the power-forming processes in the oil industry, and demonstrating the company's facilities for the fabrication of pressure vessels by fusion welding. Another interesting exhibit showed the principle of operation and a typical installation of the 'CO' boiler developed by Babcock to utilise efficiently, for steam raising, both the sensible and combustible heat content of the exhaust gases from a catalytic cracking unit.

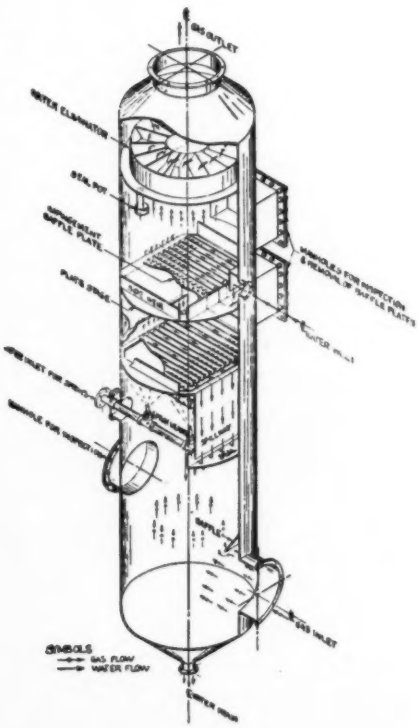
These boilers are self-contained and the CO gas ports of the boiler are supplemented by oil and refinery gas burners for starting-up and auxiliary firing. With a CO boiler the cracking unit is completely independent of other sources of steam supply.

The Babcock 'CO' boiler is claimed to effect considerable saving in fuel costs since it produces all the steam necessary for the independent operation of a catalytic cracking unit, and excess steam produced can be used for other refinery purposes, decreasing the demand on the main boiler plant. Also, steam can be produced at high temperature and pressure, facilitating a higher thermal efficiency of the prime movers in the cracking unit. Discharge to atmosphere of carbon monoxide and of unburned hydrocarbons or other combustible pollutants is also eliminated.

On the right: **Isometric drawing of Peabody scrubber described in our June issue.**

Below: **A 14-ft.-diam. stainless-steel double-cone mixer believed to be the largest of its type ever made, exhibited by W. Gardner & Sons (Gloucester) Ltd.**





On the same stand as Vokes Genspring Ltd., **Stream-Line Filters Ltd.** showed pressure- and vacuum-operated filters including the special N3 model, used for the filtration of insulating oil used in *x*-ray equipment but equally suitable for other oils such as refrigerator oil, vacuum pump oil, etc., where fine filtration and complete deaeration and dehydration is required.

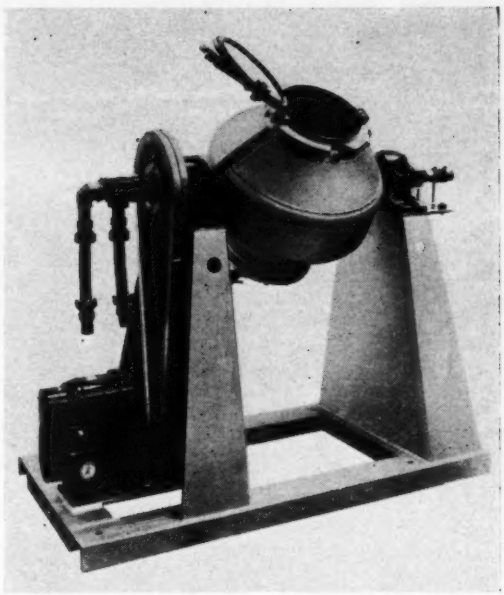
Pressure-operated filters included type P8 and P37 suitable for the filtration of lubricating oil, edible oil, disinfectants, etc., while a model PM55A filter, primarily designed for the filtration of aviation fuel, is equally suitable for dealing with solvents and similar liquids.

One of the exhibits of the **Fisher Governor Co.Ltd.** was a new development of the *Wizard* controller which should be of interest to the chemical and process industries. The *Wizard* 2 is now available with a relay and provision for integral action without materially sacrificing the compactness and simplicity of its predecessor which has been used in oil and gas field applications for many years.

In this new design, the measuring element still consists of a bourdon tube or bellows suitable for pressure ranges from 10,000 p.s.i. down to 5 p.s.i., but the back-pressure at the nozzle tip is now amplified by a relay of the non-bleed type which provides increased loading air capacity with linearity of output. Proportional band adjustment with provision for remote pressure is incorporated, while reset adjustment can also be fitted when required.

Exhibited for the first time (also by Fisher) was a blending unit for the in-line blending of intermediate grades of fuel oil. Developed in collaboration with the Shell Petroleum Co., this unit operates as a volumetric proportioning device by maintaining the same differential pressure across two orifices so that variation in volumetric ratio is attained simply by changing the orifice area ratio. The unit is entirely self-acting.

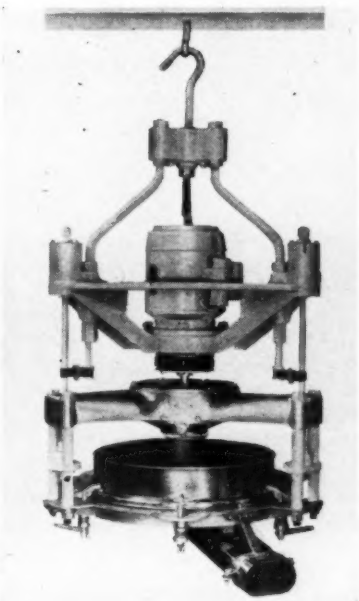
Sharing a stand with Fisher was **Elliott Bros. (London) Ltd.**, who included a display of the Swartout electronic system for indicating, recording and control. The system can be operated from a.c., d.c. or motion inputs as well as inputs from all conventional primary measuring elements. The normal measuring signal is in the range 0.00 to 0.50 volts at 50 c s, and the control signal output is normally 4 to 8 ma. d.c. Various power operators may be used, including the new Fisher electrohydraulic valve actuators types 340 and 350 which, using a simple force motor to control the hydraulic pilot, provide the high performance essential if the full advantages of electrical control are to be realised.



The Pfaudler conical glassed steel drier blender uses a tumbler-drying action to produce an extremely homogeneous product.

Here also was a display of the Bristol's *Metagraphic* (pneumatic) instruments which operate in the standard 3 to 15 p.s.i. signal range and, like the Swartout equipment, require minimum panel space consistent with good legibility. Recorders and indicators are fully interchangeable and all connections are of ' plug-in ' type.

Another exhibit will be the dry-bellows differential pressure flowmeter of the Industrial Instrument Corporation of America, which Elliott are now manufacturing and marketing in Europe.



This high-speed self-cleaning strainer was shown by Russell Constructions Ltd.

Fibreglass Ltd. showed a range of products from glass wool for thermal and sound insulation to chopped strands of continuous filament yarn for *Fibreglass*-reinforced plastics.

A range of centrifugal fans, in *Fibreglass*-reinforced plastics, for extracting corrosive fumes at medium and low pressure, are now available. Impellers are *Fibreglass* polyester dough mouldings and the castings are contact-moulded in the same materials. Of great interest is the technique of repairing corroded metal pipes and ducts with *Fibreglass* reinforcement fibres and epoxide resin. A corroded steel pipe repaired with materials in a *Thistlebond* repair kit, and instructions on how to do this, were available for inspection on the stand.

The stand also displayed various other applications of *Fibreglass*, such as the *Multi-Pak* filter for use in places where a high degree of air cleanliness is necessary. Filters can be packed with fibres of different diameters and densities to give varying degrees of efficiency.

Company News

A further expansion of the Taylor Instrument Companies, whose main office is in Rochester, N.Y., U.S.A., has just been opened under the name of Taylor Instrument GmbH. at Bockenheimer Anlage 38, Frankfurt-am-Main, Western Germany. This new associate company also ties up with Taylor Controls Ltd., London, Taylor Instrument Companies of Canada Ltd., and Taylor Instrument Companies of Australia Pty. Ltd.

The branch office in Western Germany has been started with the main object of facilitating sales, after-sales service and instrument maintenance in that area, but it is envisaged that actual manufacture of Taylor instruments will be carried out in Western Germany at a later date.

*

Honeywell-Brown Ltd. has changed its name to Honeywell Controls Ltd. In addition, all head office departments and the London branch office moved from Perivale to a new building at Ruislip Road East, Greenford, Middlesex (telephone: Waxlow 2333).

Honeywell explain that the new name identifies the company with its range of products: instrumentation, heating and air-conditioning controls, micro switches, and lines up with the names adopted by most of the company's overseas affiliates.

The new building puts all marketing functions—sales and service engineering, training school, export activities—and their executive direction under one roof.

*

Follsain Wycliffe Foundries Ltd. announce the appointment of the Johannesburg firm of H. Incledon & Co. (South Africa) Ltd. as their agents for the Union of South Africa; of J. L. Curtis Ltd. (Ndola) as agents for Northern Rhodesia, excepting Livingstone; and of Mine-Elect (Pvt.) Ltd. of Bulawayo as agents for Southern Rhodesia and Livingstone.

This follows the recent tour of those territories by Mr. W. J. W. Proctor, Follsain Wycliffe sales director.

*

Armour Chemical Industries Ltd. has taken over business of the chemical division and the Armour laboratories, hitherto part of Armour & Co. Ltd. The directors of Armour Chemical Industries are Mr. T. D. Lively, Mr. J. L. McCowan, Mr. M.. K. Schwitzer and Mr. W. F. Ticehurst, all of whom have been for many years with Armour & Co. Ltd.

*

An amalgamation of interests between Baker Perkins Ltd. and Steele & Cowlishaw Ltd. has been announced. Following the reconstitution of the board of directors, Mr. A. I. Baker (chairman of Baker Perkins Ltd.) will be the chairman of Steele & Cowlishaw Ltd., Mr. F. Limb will continue as the managing director of the company, and additional directors will be Mr. J. M. Peake (a director of Baker Perkins and manager of their chemical division) and Mr. H. S. Hargreaves (the deputy managing director of Baker Perkins (Exports) Ltd.).

Mr. John Capey, the present general manager of Steele & Cowlishaw, remains in this role as a member of the board.

*

A new instrument factory has been opened at Redhill, Surrey, by Foxboro-Yoxall Ltd. A notable feature of the factory is the absence of service lines, cables, conduits or pipes between the roof and the floor, all services being distributed through an underground tunnel which runs the length of the factory and has its main opening in the nearby power house.

Besides complete manufacturing and administrative units the new buildings at Redhill house a number of ancillary departments such as the training school run by the company and the research and development department.

*

Changes of address

Vacu-Blast Ltd. have moved into larger premises at Bath Road, Slough, Bucks., where offices and works will be combined.

*

Chemical Construction (Great Britain) Ltd. are moving to new premises at Henrietta House, Henrietta Place, London, W.1. (Tel.: Langham 6571.)

Comical Engineering Situations

"WELL, YOU CERTAINLY SEEM TO HAVE HIT ON SOMETHING THERE, JACK."

Recent Publications

'Isceon' products—a range of fluoro-halo derivatives of aliphatic hydrocarbons having applications as refrigerants, propellents, fire-extinguishing agents and intermediates for the synthesis of other fluorine chemicals and plastics—are the subject of an attractive, 134-page, illustrated booklet by Imperial Smelting Corporation Ltd., 37 Dover Street, London, W.1.

£ s d

CHEMICAL PLANT COSTS

Cost indices for the month of May 1958 are as follows:

Plant Construction Index: 171.1
Equipment Cost Index: 162.6
(June 1949 = 100)

£ s d

Diaphragm seals designed to protect pressure instruments against corrosion and clogging are described in Bulletin 250 available from Brooks Rotameter Co., P.O. Box 432, Lansdale, Pennsylvania, U.S.A.

Steam trapping. A 41-page manual on steam trapping, containing sections on the working of traps, capacity charts selection and sizing for industrial and domestic applications, testing, maintenance and trouble shooting, has been published by the Drayton Regulator & Instrument Co. Ltd., of West Drayton, Middlesex.

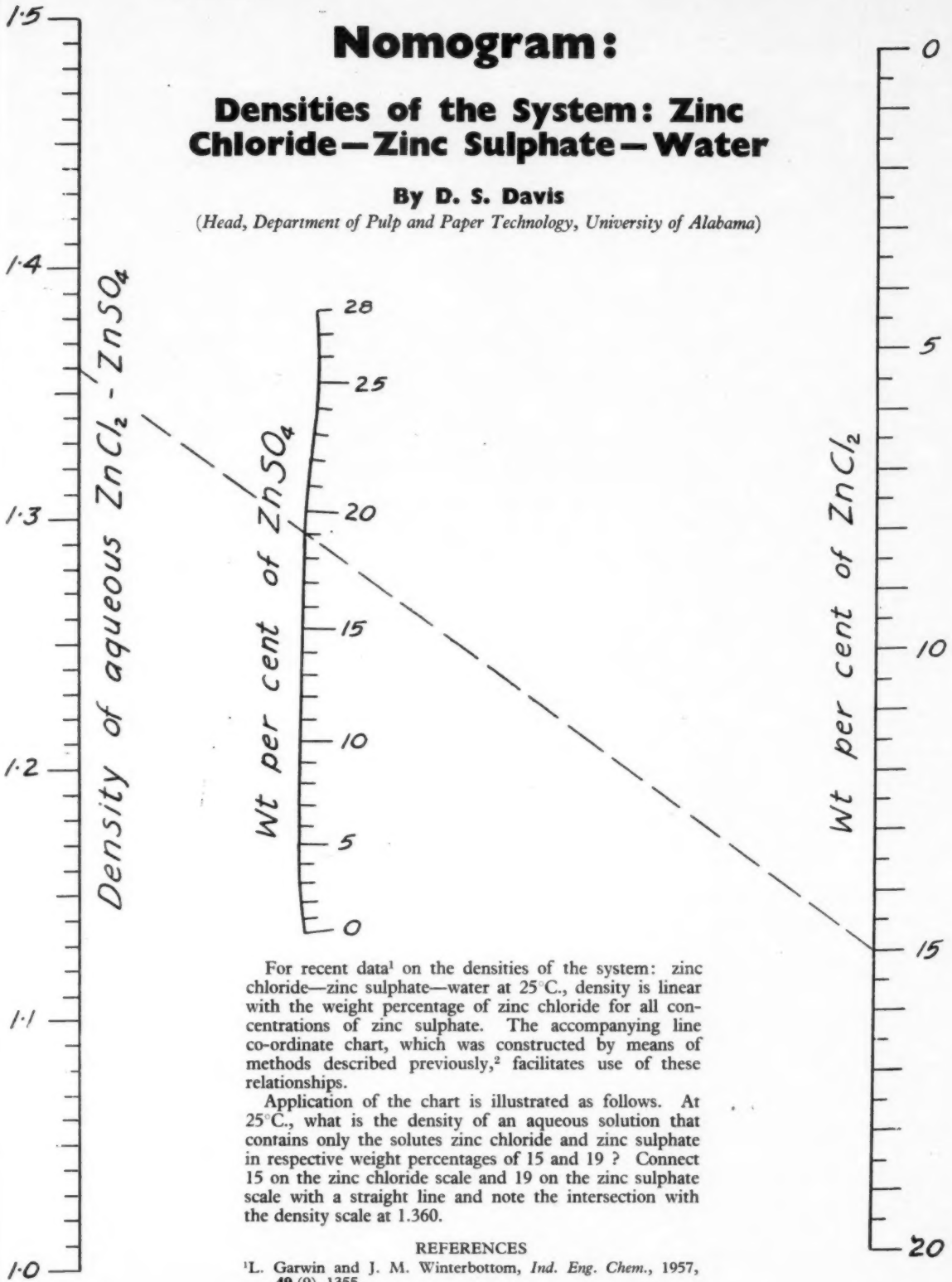
Soldering aluminium. At one time aluminium was regarded as being difficult to solder. Several practical soldering techniques are now available. The subject is discussed in the latest Aluminium Development Association's series on methods of joining aluminium and its alloys. The bulletin, price 2s., is obtainable from the Association at 33 Grosvenor Street, London, W.1.

Nomogram:

Densities of the System: Zinc Chloride—Zinc Sulphate—Water

By D. S. Davis

(Head, Department of Pulp and Paper Technology, University of Alabama)



For recent data[1] on the densities of the system: zinc chloride—zinc sulphate—water at 25°C., density is linear with the weight percentage of zinc chloride for all concentrations of zinc sulphate. The accompanying line co-ordinate chart, which was constructed by means of methods described previously,[2] facilitates use of these relationships.

Application of the chart is illustrated as follows. At 25°C., what is the density of an aqueous solution that contains only the solutes zinc chloride and zinc sulphate in respective weight percentages of 15 and 19 ? Connect 15 on the zinc chloride scale and 19 on the zinc sulphate scale with a straight line and note the intersection with the density scale at 1.360.

REFERENCES

[1]L. Garwin and J. M. Winterbottom, *Ind. Eng. Chem.*, 1957, **49** (9), 1355.

[2]D. S. Davis, ' Nomography and Empirical Equations,' Chap. 10. Reinhold Publishing Corporation, New York, 1955.

World News

NETHERLANDS

Synthetic glycerine

A plant for the manufacture of synthetic glycerine, believed to be the first one in Europe and the only one outside the United States, has now come on stream at the Pernis (Rotterdam) refinery of the Royal Dutch/Shell group of companies.

This plant, operating on a continuous basis, is the final section of a complex installed for the manufacture of a range of related industrial chemicals, the first unit of which was brought on stream in December 1956.

NORWAY

Oil refinery project

Construction of the oil refinery planned by Esso-Raffineriet A/S, the Norwegian subsidiary of the Standard Oil Co., New Jersey, will commence in the near future. The refinery will be situated at Slagen near Tönsberg on the western side of the Oslo fjord.

The construction will be financed through the floating of a loan on the Norwegian market. The refinery will have a capacity of 40,000 bbl./day. Part of the production will be exported, mainly to Sweden. It is estimated that the refinery will save Norway 70 million kroner (£3,500,000) annually in foreign currency.

Aluminium plant expansion approved

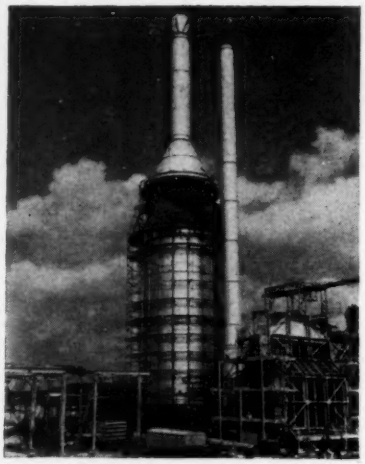
Plans for the second construction stage in the expansion of the state-controlled aluminium plant at Aardal, to cost about £20 million, have been approved by the Norwegian Parliament. Including the first construction stage, already completed, the plant expansion programme is expected to cost about £39.65 million.

The first stage increased the capacity of the plant by 32,000 tons p.a. Another 32,000 tons will be added when the second expansion phase is finished. The annual output should then be approximately 100,000 tons p.a., consuming about one-twelfth of the hydro-electric power produced in Norway.

SOUTHERN RHODESIA

Chemical project

Marble, Lime & Associated Industries Ltd., of Johannesburg, are to establish a factory in Salisbury, Southern Rhodesia, for the production of their range of chemical and associated products. Stock worth some £100,000 is subsequently to be imported from South Africa, and there is considered to be a possibility that marble and quartzite deposits in Gwelo and Umtali may later be developed.



GIANT STEAM AND AIR HEATER

This 'Petro-Chem Iso-Flow' steam and air heater has been supplied by Birwelco Ltd. for use at Esso Petroleum Co.'s Fawley refinery. With a total duty of 140 million B.Th.U. hr., it is over 170 ft. high.

UNITED STATES

Oil refinery for Venezuela

The M. W. Kellogg Co., New York, and its subsidiary, Compania Kellogg de Venezuela, Caracas, have been awarded contracts for the design, engineering, procurement, and construction of the new Socony Mobil Oil Co. de Venezuela refinery at El Palito. The process facilities of the plant will consist of a single-stage atmospheric distillation unit, including gasoline fractionation and stabilisation; a catalytic reforming unit and a caustic treating unit.

SOUTH AFRICA

Lubricating oil and greases

The Shell Oil Co.'s new lubricating oil blending plant at Durban is now a prominent landmark in that area. A staff of some 150 are operating this new plant.

Associated with the blending facilities is a grease factory, and Shell's present plans also call for a bitumen plant to produce bituminous solutions, pipeline primers, tile primers and allied lines. The final cost of the plant will thus reach about £1.3 million. Three-quarters of this sum is being spent in South Africa, and the balance on the importation of autoclaves, kettles, pumps and other specialised equipment not available in the Union.

Working on a single-shift basis, the plant last year produced about 2,800 tons of grease, and the output for the current year is estimated at 4,400 tons. Provision has also been made for the production of between 350 and 400 different grades of oils and greases. By the end of 1957, £1,107,258 had been spent on the plant, and it was expected that during 1958 a further £98,650 would be spent, raising the total investment to £1,205,908.

MEXICO

New chlorine-caustic plant

A new plant, claimed to be the largest chlorine-caustic unit in Mexico, is located in Santa Clara adjacent to Mexico City. Owned by Pennsalt Chemicals Corporation and operated by Industrial Química Pennsalt S.A. under the supervision of Pennsalt International Corporation, the plant is manned by Mexicans and utilises De Nora mercury cells. It has a rated capacity of 35 tons/day which is sufficient to meet present market demands in Mexico. Besides chlorine, the plant produces rayon-grade caustic soda, sodium hypochlorite and muriatic acid. Pennsalt also have several projects under study which will utilise chlorine and other products from the new plant as raw materials. Other Pennsalt interests in Mexico include Pennsalt de Mexico S.A., a blender and distributor of agricultural chemicals with plants located in Mexico City and Navojoa; and Minerales y Metales Industriales S.A. de C.V., operator of Mexico's largest fluorspar mine and mill facilities at San Luis Potosí.

IRAQ

Industrial developments

In preparation for its conversion to an oil refinery, the production of the Qayarah bitumen refinery has been reduced to a rate of 20,000 tons p.a., *viz.* one-third of its capacity. Demand for asphalt is to be met by the Government refinery at Daura which is already producing 40,000 tons p.a.

Iraq's first pharmaceutical factory was inaugurated recently. It was built by the Iraqi Pharmaceutical Industry Co. Ltd. under the supervision of Union Chimique Belge. Initially, the factory will produce tablets, syrups, ointments and ampoules. The layout and equipment of the factory are of a high standard.

SYRIA

Cement plans continue

Cement production at Aleppo was recently reduced because of an accumulation of stocks and an uneasy market. Nevertheless, construction of a new cement works at Aleppo, due to start production in 1959, is continuing. In addition to a cement works at Homs (under contract to Rheinstal) it is also proposed (by the Société de Ciment de Hama) to build a factory at Hama. The Government recently imposed maximum prices for cement from the factories of Aleppo and Damascus.

KOREA

Talc production

A talc plant, re-equipped and modernised with U.N.K.R.A. aid, is now in production at Chungju in Chungchong Pukto province. Although it has been in existence since 1943, production at the plant, which is owned by the Il Shin Industrial Co., has hitherto been restricted to small quantities of coarse talc of use only in paper, textile, and soap manufacture. With the new equipment the production of 500 metric tons/month of fine-ground talc will be possible.

Personal Paragraphs

★ As chief executive, chemicals division, British Oxygen, **Dr. R. F. Goldstein,** in addition to being managing director of British Oxygen Chemicals Ltd., is now managing director of Carbide Industries Ltd. and a director of Odda Smelteverk.

★ **Mr. J. E. Spence,** general sales manager of B.E.N. Patents Ltd., has been appointed a director of the company.

★ **Mr. A. Readshaw,** research chemist with Croda Ltd., will lead the production team at the new Croda Belge factory at Verviers. The factory will manufacture lanolin, which hitherto was not produced in Belgium.

★ **Mr. E. F. Liebrecht** becomes president of Kellogg International Corporation, a subsidiary of the M. W. Kellogg Co. of New York. Mr. Liebrecht, who will continue as a vice-president of M. W. Kellogg, will establish his office at Kellogg House, London. He was also elected president of Société Kellogg and will be responsible for the direction of this Kellogg subsidiary's activities in France.

R. F. Goldstein.

E. F. Liebrecht.

★ We much regret to report the death of **Major Frank H. Bramwell,** who has been on the board of directors of the Power-Gas Corporation Ltd. and Ashmore, Benson, Pease & Co. Ltd. since April 1949. He spent most of his working life with Imperial Chemical Industries Ltd., the latter part as chief engineer of their general chemicals division. He was keenly interested in all technical developments and right up to his death was active in the affairs of civil, mechanical, electrical and chemical engineering institutions.

★ **Mr. J. R. Moore** has been appointed a director of the Fisher Governor Co. Ltd.

★ **Mr. George Boex,** a former managing director of the British Aluminium and associated companies, has retired from the board by rotation and, owing to advancing years, does not wish to seek re-election. He will continue in a consultative capacity.

★ **Mr. S. A. Gregory,** who has been appointed technical manager of the drier division of Birlec Ltd., has specialised in a number of aspects of chemical engineering, including process and plant design. During the war he was engaged in the development of processes for the manufacture of alumina from china clay and carbides, air filter development and pump application. From 1944 to 1951 he was engaged on the design and application of distillation and fermentation plant and heat transfer equipment. In 1951 he became head of the Frodingham research department at the Appleby-Frodingham Steel Co., where his main activities were concerned with the manufacture of iron and steel by chemical processes. At the beginning of 1957 he joined the Audley Engineering Co. Ltd. as technical manager.

B. H. Turpin, managing director of Quickfit & Quartz Ltd. and of Q.V.F. Ltd. recently re-elected to the Council of the B.C.P.M.A. (See C.P.E. June, page 234).

★ **Dr. R. H. Dodd,** the new managing director of Chemical Construction (Great Britain) Ltd., is an American-born chemical engineer who came to the United Kingdom in 1945 and stayed until 1950, during which time he formed the Lummus Co. Ltd. and became its first general manager. After returning to New York he served with the Lummus Co. there and later took leave of absence for 2½ years to become professor and head of the School of Chemical Engineering at Oklahoma State University. In 1957 he was appointed director of the Lummus engineering development centre at Newark, New Jersey.

J. E. Spence.

The previous managing director of Chemical Construction, **Mr. M. S. Henderson,** is retiring but will continue as a director of the company for the present.

★ The British Rubber and Resin Adhesive Manufacturers' Association has re-elected **Mr. N. G. Bassett Smith,** general manager of Dunlop's compositions division, vice-chairman of the association for another year. **Mr. A. A. Round,** the division's works manager, has been elected chairman of the association's technical panel and he will represent the adhesive manufacturers on the technical committee of the Federation of British Rubber and Allied Manufacturers.

★ **Dr. P. H. Sykes,** a director of the British Oxygen Co. Ltd., has been elected chairman of the Low Temperature Group of the Physical Society.

WHAT'S NEWS about

★ Plant
★ Equipment
★ Materials
★ Processes

This illustrated report on recent developments is associated with a reader service that is operated free of charge by our Enquiry Bureau. Each item appearing in these pages has a reference number appended to it; to obtain more information, fill in the top postcard attached, giving the appropriate reference number(s), and post the card (no stamp required in the United Kingdom).

Electro-hydraulic valve operation

Recent trends towards electrical control loops have created a need for final control elements capable of utilising their greater sensitivity and speed, point out the Fisher Governor Co. Ltd., who announce the introduction of two types of self-contained electrically operated valve actuators. They produce high performance without the use of electronic amplification, employing only a simple d.c. electrical circuit to control the hydraulic pilot, it is claimed. The pilot systems incorporate no close-fitting parts, but use simple nozzle-flapper combinations to control hydraulic pressure.

There are two sizes available, each adaptable to all d.c. output signals. The type 340 has a maximum stem thrust of 600 lb. and is suitable for valve sizes from ¼ to 4 in., while the larger type 350 develops a thrust of 2,000 lb. and is usable for all valve sizes up to 16 in. **CPE 946**

Stress-relieving for heavy vessels

A new stress-relieving furnace is coming into use, an automatic welding machine is being introduced, new *x*-ray examination facilities have been installed, and an extended constructional shop is providing additional facilities for heavy fabrication at the Thorncliffe Works of Newton Chambers & Co. Ltd. Though primarily for the use of the company's own engineering division, linking with its Class I welding work on pressure vessels and the like, the new furnace will be available for the stress-relieving of vessels fabricated by other contractors.

This furnace is one of the largest in the country and is capable of taking vessels up to 15 ft. in diameter and 100 ft. in length, with a weight of 60 to 70 tons.

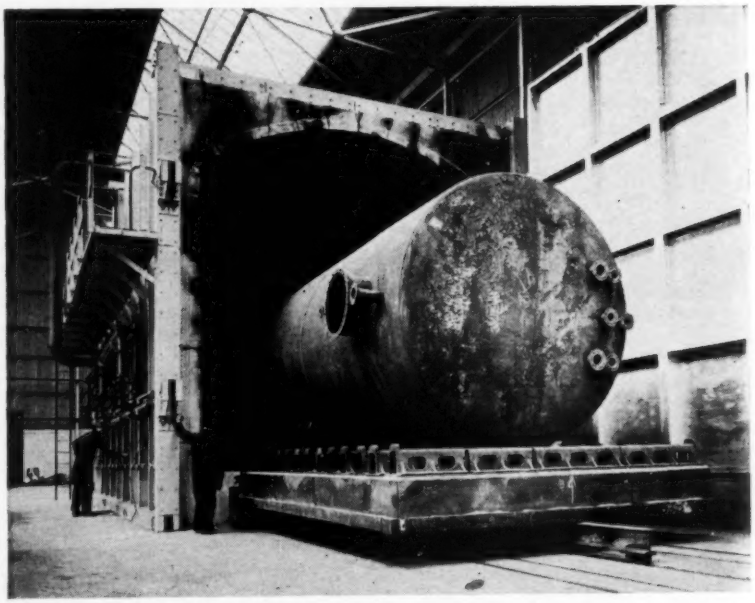
It is gas-fired and its automatically-controlled temperature range is from 300°C., for use in curing synthetic linings, to a maximum of 1,000°C., for the heat treatment of stainless-steel fabrications, etc.

The new, electronically-controlled welding plant is of the *Union Melt* type with 2,000 amp. capacity. **CPE 947**

Packing for induced-draught cooling towers

A system of packing for induced-draught cooling towers, known as *Film Flow*, is claimed to distribute the liquid evenly over the packed area of the tower and to give the cooling air unimpeded access to all parts of the packing.

The water is led to the tower either in a closed pipe or in an open culvert from which it is discharged into secondary troughs through orifices specially designed to prevent splashing. From the secondary troughs it is fed into weir-type spreader troughs running the entire length or breadth of the tower at a pitch of 6 in. The



Mild-steel storage vessel, with dished ends, going into the new stress-relieving furnace at Newton Chambers' works at Thorncliffe.

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spreader troughs, which have specially shaped notches at 2 or 4-in. intervals, rest on the top layer of the tower filling. The filling is composed of a number of horizontal trays of parallel laths, the direction of each layer of laths being at right angles to the trays above and below it. The effect in plan view is of a grid composed of 2-in. square network and the water upon being discharged through the trough walls flows down the grid packing in an even film changing direction through 90° in every 2 in. down the whole depth of the track.

The salient feature of the system, according to the makers, Film Cooling Towers (1925) Ltd., is saving in space. **CPE 948**

Refractory material

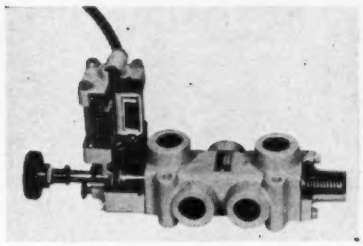
A ceramic material comprising high-purity zircon in an easily workable form is *Zirconite* which can be sawn, drilled, filed, turned and shaped and is stable at 1,500°C. It is available in rounds, squares and slabs and can be used in a wide variety of high-temperature operations. Details can be obtained from W. C. Spicer Ltd. or by using the reply-paid postcard. **CPE 949**

Flameproof motor

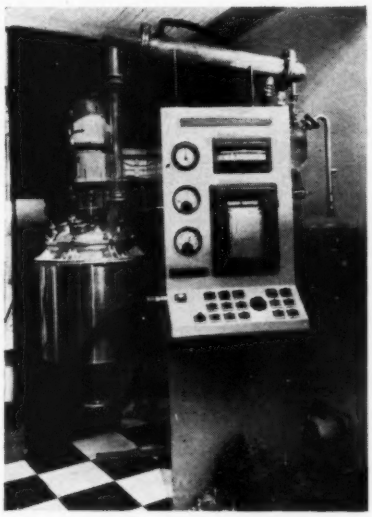
The new Worthington-Simpson range of flameproof, totally enclosed, fan-cooled, squirrel-cage induction motors has been designed to meet Groups I and II gases and comply fully with B.S. 229 : 1957 for flameproof enclosure and B.S. 2613 : 1957 for electrical performance. The sizes range from 1 h.p. to 7½ h.p., 1,450 r.p.m. and 1½ h.p. to 12½ h.p., 2,900 r.p.m. **CPE 950**

Metal spraying

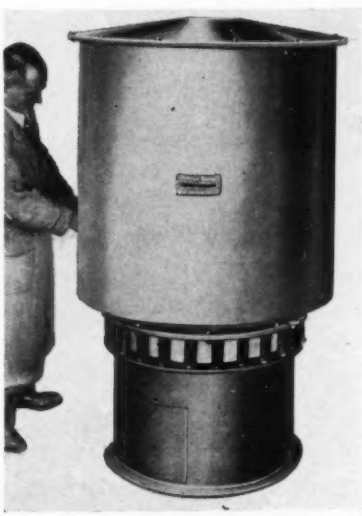
A new metal-spraying gun, equally suited for use as an individual unit or as an integral part of a large production set-up, has been introduced by Metallizing Equipment Co. Ltd. The metal to be sprayed is in wire form and is passed through a nozzle where it is heated by an oxygen-gas flame. A blast of compressed air surrounding the wire nozzle atomises and deposits the metal on to a prepared surface. The resultant deposit ranges from 0.001 in. to ¼ in. or more, has the corrosion qualities of the metal sprayed and extreme wear resistance. The compressed air also keeps the sprayed surface cool. **CPE 951**



Standard ½-in.-bore, 4-way, solenoid-operated control valve, fitted with over-riding manual control and lock.



L. A. Mitchell's 10-gal. induction-heated pilot plant.



Podmore-Boulton 'Vibro-Energy' mill.

Fine grinder

A new machine, which effects fine grinding with close control by high-frequency, small-amplitude vibration, has been announced jointly by William Boulton Ltd. and W. Podmore & Sons Ltd. Easy and accurate control of particle size, coupled with freedom from contamination, are claimed as the greatest advantages of this machine. The entire weight of the chamber and its contents is supported on high-tensile steel springs, thus eliminating the need for heavy bearings. The starting torque is low, consequently a direct on starter can be used and clutch and gearing become unnecessary. A minimum of maintenance is therefore required. Heat, which is always generated during grinding, can be dissipated through the top of the container, an important factor in the grinding of varnishes, resins and certain organic materials which tend to coagulate with excessive heat. **CPE 952**

Solenoid valve with over-riding manual control

For actuating a solenoid-operated fluid power control valve when the electrical supply is not available (*e.g.* when there is a supply failure or during installation and testing of the equipment) a mechanism is available which permits manual operation by simply pushing a large knob with the palm of the hand.

Operation is by means of a shaft which enters through the end cover of the valve and makes contact with the pilot piston head which in turn is connected to the spool. When the over-ride shaft is depressed, it moves the spool from the 'normal' to the 'operated' position. The spool can be locked into the operated position by rotating the over-ride shaft when it is fully depressed, whereupon a 'D'-shaped collar on the shaft locates behind the head of a locking screw. The locking position is positively indexed which ensures that the mechanism remains firm in the event of vibration. In order to prevent the knob from moving in and out with the normal operation of the spool, the shaft is not actually fixed to the spool, but only rests against it.

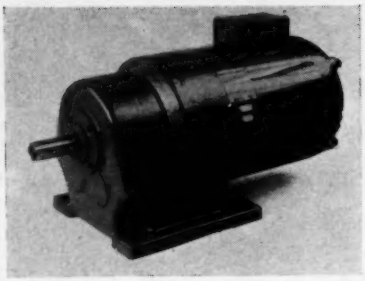
At present the over-ride feature is available as standard on ¼-in. and ½-in. bore control valves only. In addition to being used on solenoid valves, it can also be used on pilot-operated valves. Makers are Baldwin Instrument Co. Ltd. **CPE 953**

Small electric motors

An addition to their range of geared electric motors, type DS, has been introduced by Neco Geared Motors Ltd. The new motors are made for $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{3}$, and $\frac{1}{2}$ h.p. outputs. As compared with the existing motors of these outputs the length has been reduced by between $3\frac{1}{2}$ and $2\frac{5}{8}$ in., the height by $1\frac{3}{4}$ in., the width by $1\frac{1}{2}$ in., and the weight by up to 40 lb., with a corresponding saving in cost.

A very wide range of (single) final shaft speeds is available, from 0.5 r.p.m. to 475 r.p.m. without change of dimensions. Speed reduction is by spur gearing, with final and motor shafts coaxial, the gears running on ball bearings in an oilbath, with oil-seals on both shafts. The gears transmit torques up to a maximum of 100 lb.-ft. continuously.

The motors, made by the associated Normand Electrical Co. Ltd., can be either three-phase squirrel cage, or single-phase capacitor or repulsion start induction, or d.c., for all normal voltages, and may be either drip-proof or totally enclosed, or T.E.F.C. Two-speed and synchronous three-phase motors are also available.



Neco geared electric motor, type DS.

Type DS geared motors are available for running in any specified position, and a flange mounting model will be available very shortly.

CPE 954

Flame failure control

A photocell and electronic circuit that is sensitive to flame only and not affected by radiation is used in a device offered by Ether. Two types are available: Semi-automatic and fully automatic.

Failure of the flame in a gas- or oil-fired heating unit is followed by shutting off of the fuel supply, and then an automatic purging. In the case of the semi-automatic system reignition must be performed by some other means. In the fully automatic type relighting of the main burner is effected by this unit.

CPE 955

Induction-heated resin plant

A 10-gal. induction-heating pilot plant, manufactured by L. A. Mitchell in conjunction with Metropolitan Vickers Ltd., of Trafford Park, Manchester, has been specially designed for esterification and polymerisation reactions. It is extremely flexible and can be arranged to suit almost every possible method of processing, where chemical reaction needs to be controlled between very fine limits.

The standard unit can be fitted with reactors ranging from 5 to 25 gal. capacity, and these reactor units can be fitted quite simply to the main assembly so that it is possible for the one unit to have a range of between 1 and 25 gal. The reactor itself is held on a hydraulic cam, so that there is no necessity to remove the top head when making modifications to either stirring, or for normal cleaning operations. The cam is operated from a control panel, and it is only necessary to release the quick-release nuts on the kettle head to open up the reactor.

This installation is fully automatic and very well instrumented, and it is possible to pre-set any temperature between 0 and 400°C., and to have this constantly maintained between $\pm$ 1°C.

The reactor unit can be fitted with a fixed or multi-speed stirrer and it is stated that a vacuum of 29.5 in. mercury can be quite successfully achieved and maintained.

CPE 956

Reinforced plastics for corrosive liquors

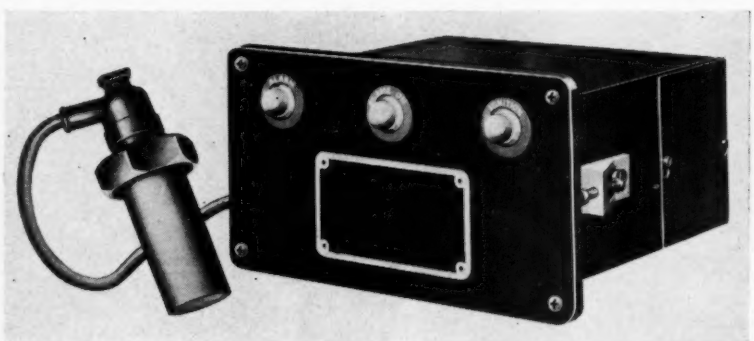
Following their intensive development of acid- and alkali-resistant plastics which culminated in the present range of *Keebush* corrosion-resistant plant, the Kestner Evaporator and Engineering Co. Ltd. have carried out an exhaustive research into glass-fibre-reinforced plastics to provide plant of enhanced mechanical strength. The new range is presented under the name of *Keeglas*.

The mechanical properties have proved to be such that reaction vessels may be supported upon *Keeglas* frames. A recent example is a cylindrical vessel for mercuric chloride with a capacity of 250 gal. or 1 ton. This is 4 ft. 3 in. diam. and 3 ft. 6 in. deep, mounted, with a Kestner 1-h.p. vertical stirrer fitted with a *Keeglas* shaft and propeller, on a *Keeglas* frame. The whole unit is, therefore, of the same contact. There is no reinforcing other than *Keeglas*, hence the supporting framework is as inert to corrosive attack as the vessel itself. This overcomes the problems usually set by spillage, dripping and so on.

Two standard grades of *Keeglas* are now available. Both are suitable for working up to 100°C., but the 'E' grade, as opposed to the 'F' grade, can withstand a working temperature of 130°C. maximum.

In addition to these two grades, alternative grades are available for special duties. An example is glass fibre and furane resin laminate backed by glass fibre and polyester resin laminate providing extreme strength and resistance to corrosion. There are also combinations of epoxy resins and polyester resins with glass fibre base in the form of a double laminate.

Alternative fibres to glass are currently developed to provide specialised structural materials. **CPE 957**



Flame failure detector.